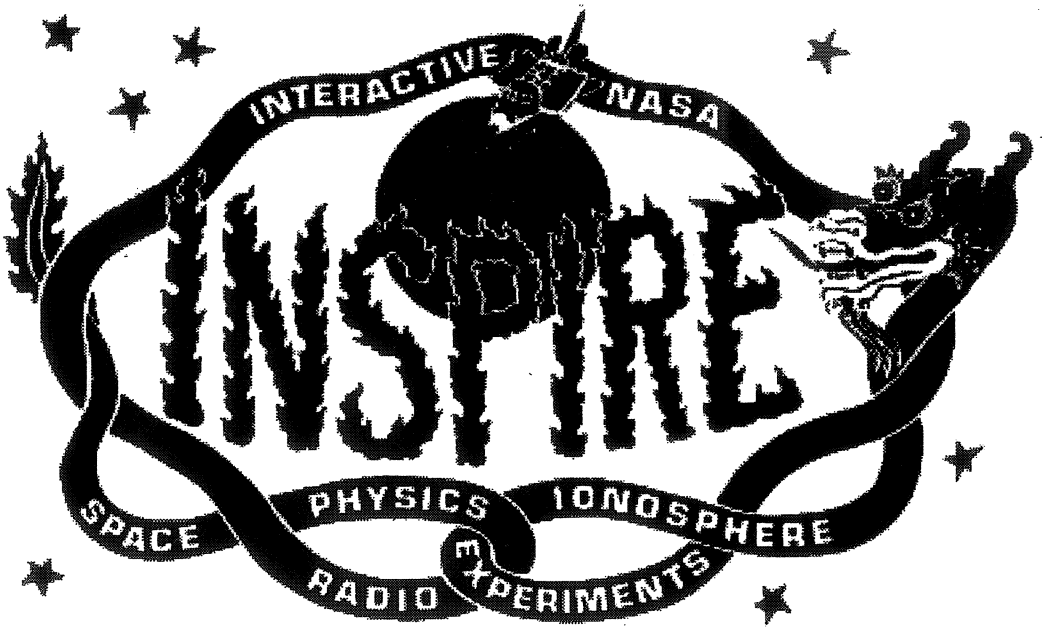

The INSPIRE Journal

Volume 6 Number 1

November 1997

INSPIRE Survey Included With This Issue

A survey of all past and present INSPIRE participants has been included with this issue of *The INSPIRE Journal*. The purpose of the survey is to evaluate all aspects of The INSPIRE Project including all past and present activities. We would also like to get ideas for future activities and projects.

As an incentive, a one-year (2 issues) subscription to *The INSPIRE Journal* will be given to each person who returns a completed survey. In addition to responding to the survey questions, please feel free to include any comments, complaints and suggestions that you feel would be helpful to INSPIRE organizers. Thank you in advance for your time and assistance.

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The INSPIRE Journal
Volume 6 Number 1
November 1997

The INSPIRE Journal is a publication of The INSPIRE Project, Inc., a nonprofit educational/scientific corporation of the State of California. The purpose of the INSPIRE Project, Inc., is to promote and support the involvement of students in space science research. All officers and directors of the corporation serve as volunteers with no financial compensation. The INSPIRE Project, Inc., has received both federal and state tax-exempt status (FEIN 95-4418628). The *Journal* is published two times per year: November 1 and April 1. Submission deadlines: October 1 and March 1

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INTMINS-November/97 Operations Schedule

By Bill Taylor, Washington, DC
Stas Klimov, Moscow, Russia
Bill Pine, Ontario, CA

The November 1997 INTMINS Operations schedule has been determined. Operations will occur on the last two weekends: November 22-23 and November 29-30. Data gathered will be analyzed and reported on in the April 1998 issue of *The INSPIRE Journal*.

Gathering Data:

IMPORTANT NOTE: Data gathering procedures will remain the same as those used since April 1996.

Perhaps the most important ingredient in a successful data gathering session is what happens **before** you go out in the field. The following is the recommended procedure for data gathering including preparation prior to the date of the operation.

Step 0: Completely check out all equipment. A good method is to set up everything in your living room. All you will hear is household 60 Hz, but you will know the equipment is working. This is also a good time to fill out the log cover sheet (see the page 57 of the *Journal*).

Step 1: Define "T-time" as the starting time for operation of ISTOCHNIK.
Convert the UT time to local time.
Arrive at your site with time to spare.

Step 2: Start data recording at T minus 12 minutes.
Prior to this time place a brief voice introduction on the tape identifying the observers and the operation number.

Step 3: Place time marks on the tape at: T-12, T-10, T-5, T, T+3, T+8, T+13, and near the end of the tape. Use UTC times only. Note that this schedule brackets the scheduled time of operation of ISTOCHNIK with time marks. Use 60 minute tapes and place one operation per side.

Step 4: Keep a written log (see page 58 of the *Journal*) of time marks and descriptions of everything you hear.

Step 5: Review your tapes and revise your logs if necessary.

Step 6: Mail your tapes and logs to Bill Pine at the address shown on Page 2.
Your tapes will be returned to you.
Send in copies of your logs since they will not be returned.
You will receive a copy of the spectrographs made from your data.
Your data will be incorporated in the data analysis report article in the *Journal*.

Mode of Operation:

The two instruments on MIR are Ariel and ISTOCHNIK. Ariel is a plasma generator and operates for 5 minutes, alternating between axes. ISTOCHNIK is a modulated electron gun that accelerates a beam of electrons and emits them into space. The electron beam is turned on and off at frequencies of either 10 hertz or 1000 hertz (1 kHz), which should cause the radiation of electromagnetic waves in the VLF range at those two frequencies. ISTOCHNIK operates for a total of 2 minutes on the following schedule:

ISTOCHNIK mode:	10 seconds modulate at 10 Hz
	10 seconds modulate at 1000 Hz
	10 seconds modulate at 10 Hz
	10 seconds modulate at 1000 Hz
	repeat for 2 minutes of operation

On each pass, Ariel will either operate first or last, whichever gives the most coverage over INTMINS observers. Since the signal from ISTOCHNIK is more powerful, it is the one most likely to be detected. For that reason, the schedule emphasizes the operation of ISTOCHNIK.

Notes on Time Marks and Logging;

The purpose of putting time marks on the data tapes is twofold:

1. The obvious need to know what time is represented in each part of the tape,

2. also to provide a means of synchronizing the tape with actual time. Battery operated recorders tend to run slower as the batteries wear out. Some recorders run fast or slow because of the particular motor being used. By timing (with a stopwatch) the actual times between time marks, the speed of the analysis recorder can be adjusted to synchronize the data tape with actual time. This has the effect of adjusting the frequencies on the spectrogram to the proper values since incorrect tape speed on the data recorder will cause the frequencies to be out of position.

When time marks are put on the tape, they should include an announcement of the UT time and a mark (either by voice ("mark") or by WWV tone or some other means). Try to minimize the interruption to the data flow when putting on the time marks. This takes practice! Also, put the time marks on at least as often as is called for by the instructions. It is better to have more time marks than are called for than to have too few.

The purpose of the data log is to record the contents of the tape. The time of each time mark should be recorded. Anything else of interest should be noted on the log with the time indicated.

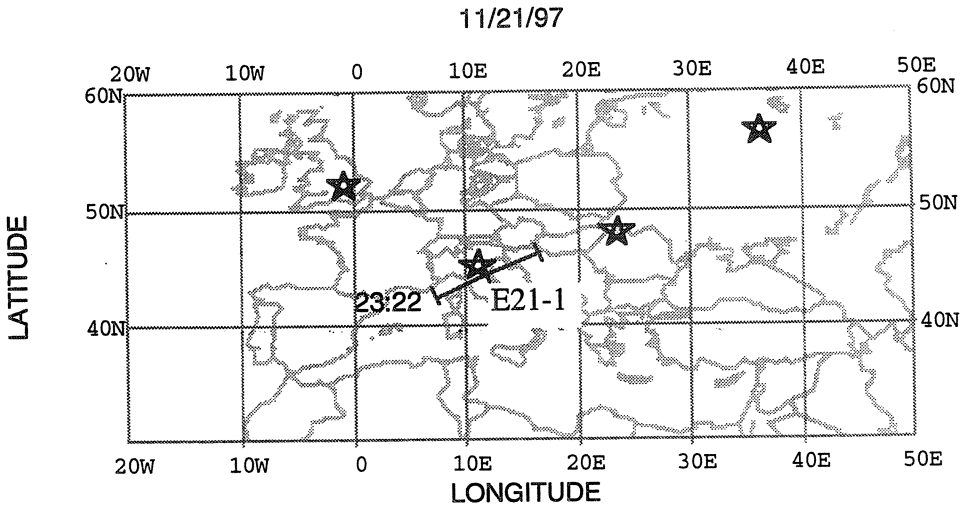
Tapes with incomplete or missing time marks and poor logs are nearly impossible to analyze. Your help in following good time mark and logging procedures is much appreciated.

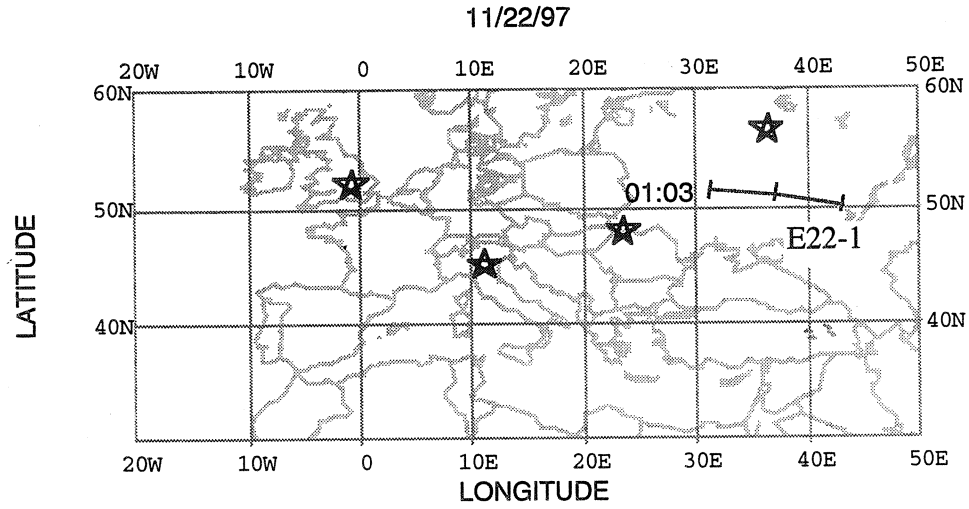
INTMINS-April/97 Operations Schedule

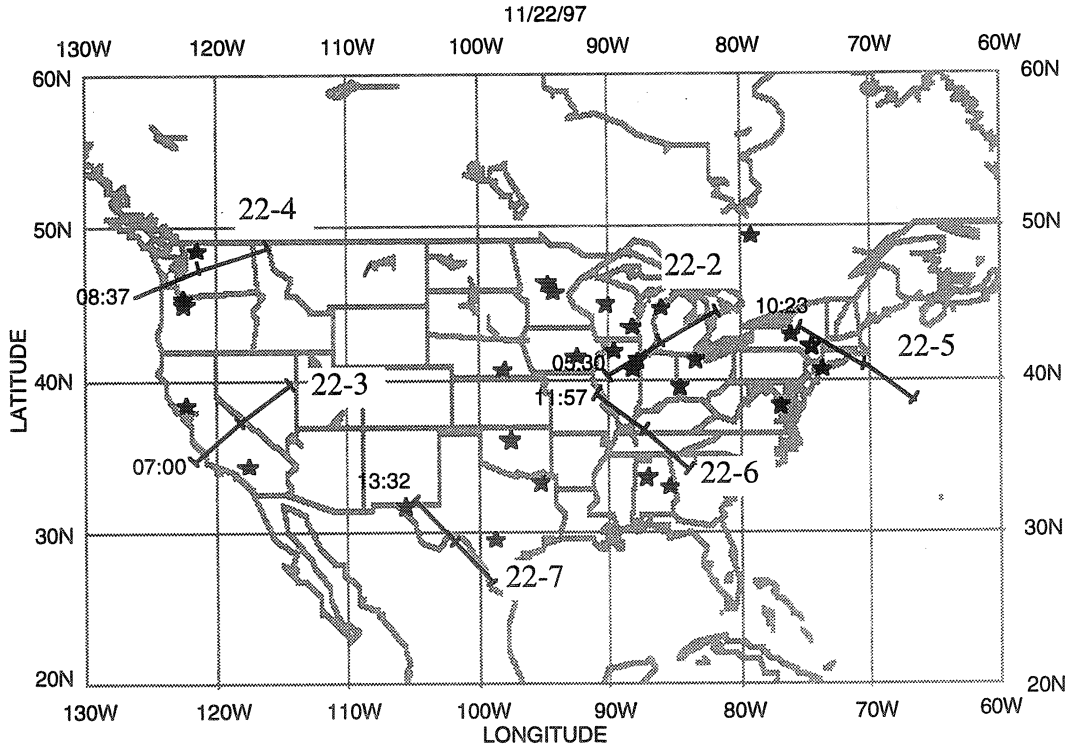
The following maps show the ground track of MIR while ISTOCHNIK is operating. The time indicated on the map is the "T-time" (all times are UT).

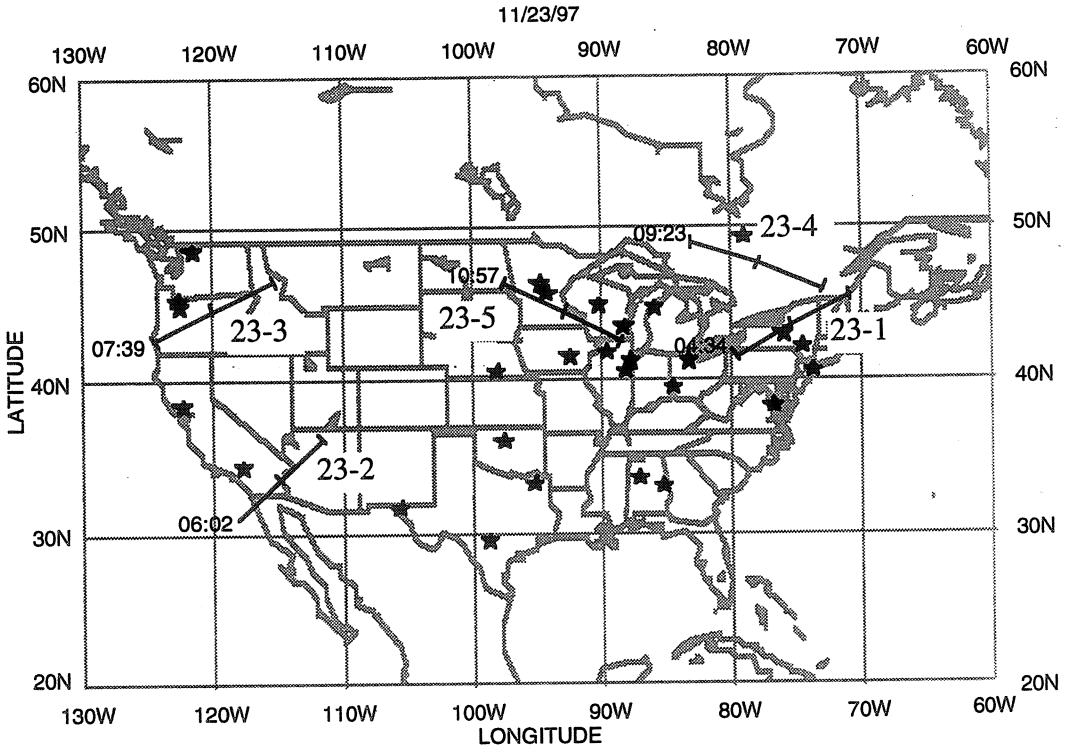
On all passes, MIR moves from west to east (left to right). The ground track shown is 2 minutes long which corresponds to the actual firing time of ISTOCHNIK. The passes are numbered with the UT date followed by the operation number on that day. Some passes late in the day are on the PREVIOUS date LOCAL TIME. Operations are numbered sequentially although they may not occur on consecutive orbits. European passes are identified with an "E".

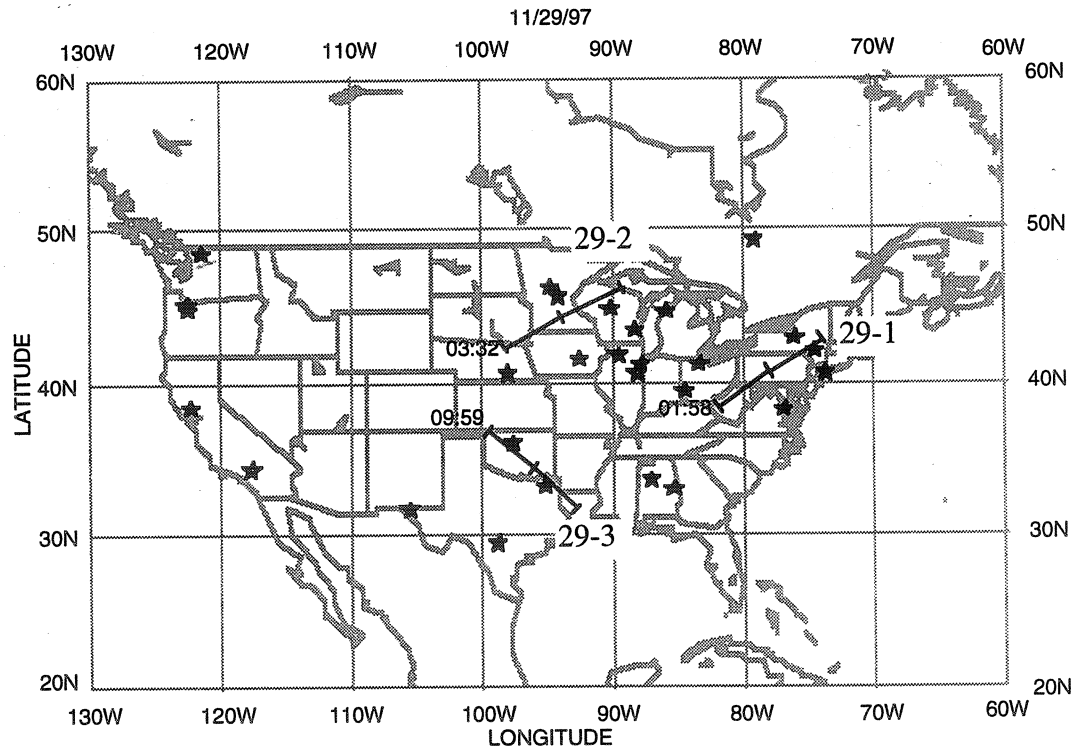
Pass Number	UT Date	Tape Start UT	ISTOCHNIK Start (T-time) UT	Tape Stop UT
E21-1	11/21	2310	2322	2335
E22-1	11/22	0051	0103	0116
22-2	11/22	0518	0530	0543
22-3	11/22	0648	0700	0713
22-4	11/22	0825	0837	0850
22-5	11/22	1011	1023	1036
22-6	11/22	1145	1157	0010
22-7	11/22	1320	1332	1345
23-1	11/23	0422	0434	0447
23-2	11/23	0550	0602	0615
23-3	11/23	0727	0739	0752
23-4	11/23	0911	0923	0936
23-5	11/23	1045	1057	1110
29-1	11/29	0146	0158	0211
29-2	11/29	0320	0332	0345
29-3	11/29	0947	0959	1012
E29-4	11/29	2016	2028	2041
E29-5	11/29	2156	2208	2221
E29-6	11/29	2326	2338	2351
30-1	11/30	0048	0100	0113
30-2	11/30	0218	0230	0243
30-3	11/30	0353	0405	0418
30-4	11/30	0537	0549	0602
30-5	11/30	0847	0859	0912

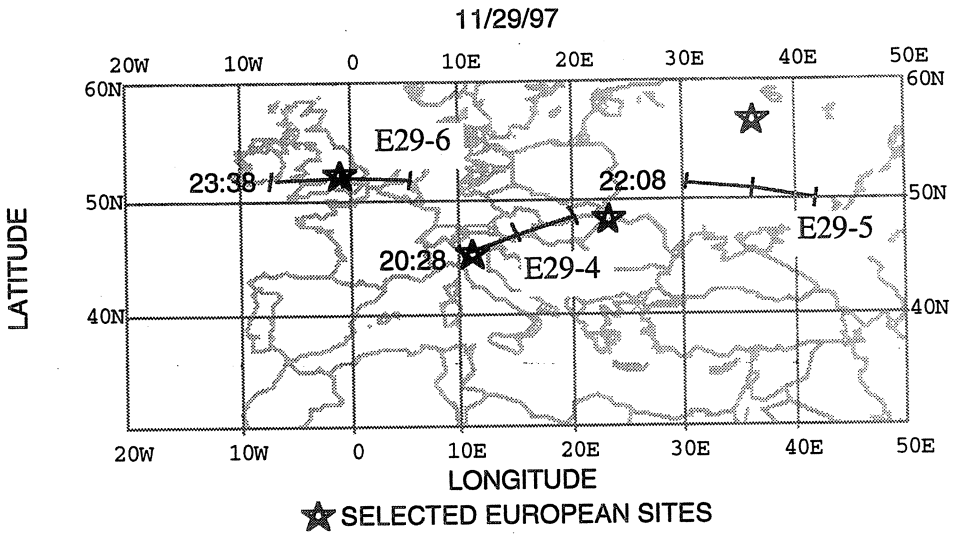

11/21/97
20W
10W
0
10E
20E
30E
40E
50E
60N
50N
40N
LATITUDE
23:22
E21-1
LONGITUDE

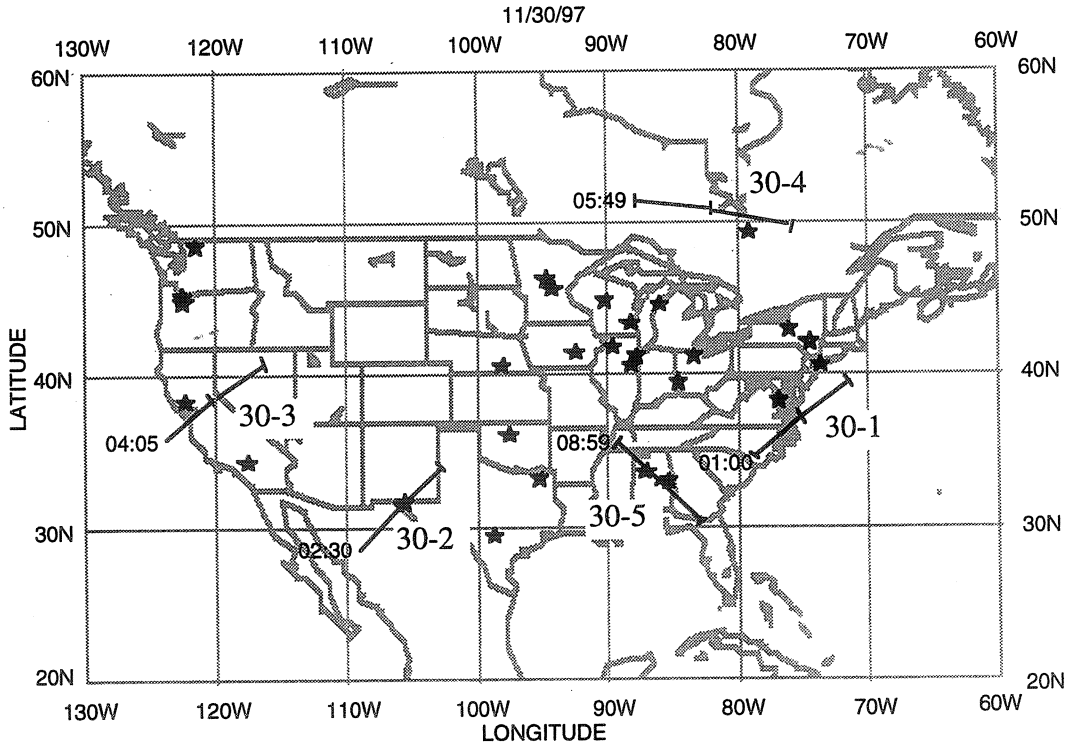

11/22/97
20W
10W
0
10E
20E
30E
40E
50E
60N
50N
40N
LATITUDE
01:03
E22-1
LONGITUDE


11/22/97
130W
120W
110W
100W
90W
80W
70W
60W
60N
50N
40N
30N
20N
LATITUDE
22-4
08:37
22-2
10:23
22-5
09:30
11:57
22-3
07:00
13:32
22-6
22-7
LONGITUDE


11/23/97
130W
120W
110W
100W
90W
80W
70W
60W
60N
50N
40N
30N
20N
LATITUDE
LONGITUDE
23-4
09:23
10:57
23-5
23-3
07:39
23-1
04:34
23-2
06:02


11/29/97
130W
120W
110W
100W
90W
80W
70W
60W
60N
50N
40N
30N
20N
LATITUDE
LONGITUDE
29-2
03:32
29-1
01:58
09:59
29-3


11/29/97
20W
10W
0
10E
20E
30E
40E
50E
60N
50N
40N
E29-6
23:38
22:08
E29-5
20:28
E29-4
LATITUDE
LONGITUDE
SELECTED EUROPEAN SITES


11/30/97
130W
120W
110W
100W
90W
80W
70W
60W
60N
50N
40N
30N
20N
30-4
05:49
30-3
04:05
30-1
01:00
08:59
30-5
02:30
30-2
LATITUDE
LONGITUDE

UT to Local Time Conversion Table for T-times
(North American Passes)

Operation	UT Date	T-time	EST UT-5	CST UT-6	MST UT-7	PST UT-8
22-2	11/22	0530	0030	2330 *	2230 *	2130 *
22-3	11/22	0700	0200	0100	0000	2300 *
22-4	11/22	0837	0337	0237	0137	0037
22-5	11/22	1023	0523	0423	0323	0223
22-6	11/22	1157	0657	0557	0457	0357
22-7	11/22	1332	0832	0732	0632	0532
23-1	11/23	0434	2334 *	2234 *	2134 *	2034 *
23-2	11/23	0602	0102	0002	2302 *	2202 *
23-3	11/23	0739	0239	0139	0039	2339 *
23-4	11/23	0923	0423	0323	0223	0123
23-5	11/23	1057	0557	0457	0357	0257
29-1	11/29	0158	2058 *	1958 *	1858 *	1758 *
29-2	11/29	0332	2232 *	2132 *	2032 *	1932 *
29-3	11/29	0959	0459	0359	0259	0159
30-1	11/30	0100	2000 *	1900 *	1800 *	1700 *
30-2	11/30	0230	2130 *	2030 *	1930 *	1830 *
30-3	11/30	0405	2305 *	2205 *	2105 *	2005 *
30-4	11/30	0549	0049	2349 *	2249 *	2149 *
30-5	11/30	0859	0359	0259	0159	0059

NOTE: An asterisk (*) indicates a local date on the date PRECEDING the UT date. Late evening passes are on the date preceding the UT date.

Example: Operation 23-1 has a T-time of 0434 UT on 4/19. In New York, where this operation is best situated, participants would record using a T-time of 2334 EST on 11/22/97.

Good-bye OMEGA

By Bill Taylor
President, The INSPIRE Project, Inc.
Washington, DC

Well, they did it. As they have been telling us they would for some time now, the US Government turned off the OMEGA radionavigation stations. As of 0300 UT on September 30, 1997, OMEGA no longer exists. It's good for the US Government's budget and, as a taxpayer, I'm happy because GPS does a much better job of locating your position. As an INSPIRE participant, though, I'm sad because OMEGA was such a great time and frequency calibration tool and because it was such a good indicator of correctly operating INSPIRE receivers. Not that we don't have other tools, of course. WWV is a great time standard, it's just a little harder to use. And the Navy's VLF stations are very good frequency standards, but they are still harder to use. Finally, sferics are the best way to tell that an INSPIRE receiver is working.

OMEGA Background

To quote from the US Coast Guard's description of OMEGA at

http://www.navcen.uscg.mil/omega/omegaff.htm

(the Coast Guard was responsible for OMEGA):

> OMEGA is a very low frequency (VLF), continuous, passive, en route, radionavigation system usable by mariners, aviators and others worldwide. Precise time can also be determined from OMEGA.
>
> OMEGA was developed by the United States and is operated in partnership with six other nations. OMEGA signals from eight stations provide an all-weather navigational capability nearly worldwide. The stations are operated by Norway, Liberia, United States (two), France, Argentina, Japan and Australia. The US Coast Guard is responsible for the operation and maintenance of the OMEGA system.
>
> OMEGA signals are phase-synchronized and are transmitted on a time-shared basis, according to the OMEGA Radionavigation System Signal Transmission Format. The stations transmit four common frequencies (10.2, 11.05, 11-1/3 and 13.6 kHz) and one frequency unique to each station. All frequencies are usable for navigation.
>
> The accuracy of Omega is 2-4 miles, with 95% confidence. The accuracy obtainable depends upon geographic location and direction of travel, stations used, signal propagation anomalies, season, time of day and receiving equipment. The primary limitation on OMEGA accuracy is variations in signal propagation. Errors that result from these variations can be reduced by applying corrections for predicted conditions to the receiver's readings either manually or automatically. The system's coverage has been validated on a regional basis. As each geographic area was validated, a report on operational limitations was promulgated.

And from the main WWW site for OMEGA,

http://www.navcen.uscg.mil/omega/

All eight OMEGA stations (NORWAY (A), LIBERIA (B), HAWAII (C), NORTH DAKOTA (D),
LA REUNION (E) ARGENTINA (F), AUSTRALIA (G) AND JAPAN (H))
around the world have permanently ceased to operate.

Users must no longer depend on OMEGA broadcasts for navigation of any kind.

Omega operated in an outstanding manner for over twenty-six years. It was the first world wide Radionavigaton system and has served as an exemplary model of International cooperation.

Data Without OMEGA

I have recorded data today to see what it sounds and looks like without OMEGA. Figure 1 is ten seconds of data with OMEGA, followed by calibration frequencies of 11.905, 12.649 and 14.881 kHz (the ALPHA station frequencies, more about ALPHA later) and finally, 10 seconds of data without OMEGA, recorded on September 30, 1997, about 1845 UT at Goddard Space Flight Center. Note by the way that the signals are remarkably free of 60 Hz and harmonics, even though I was only about 100 meters from a large building. You don't have to be a kilometer away from power lines to get good signals, sometimes even in your backyard or street is good enough to hear strong tweeks. Try it!

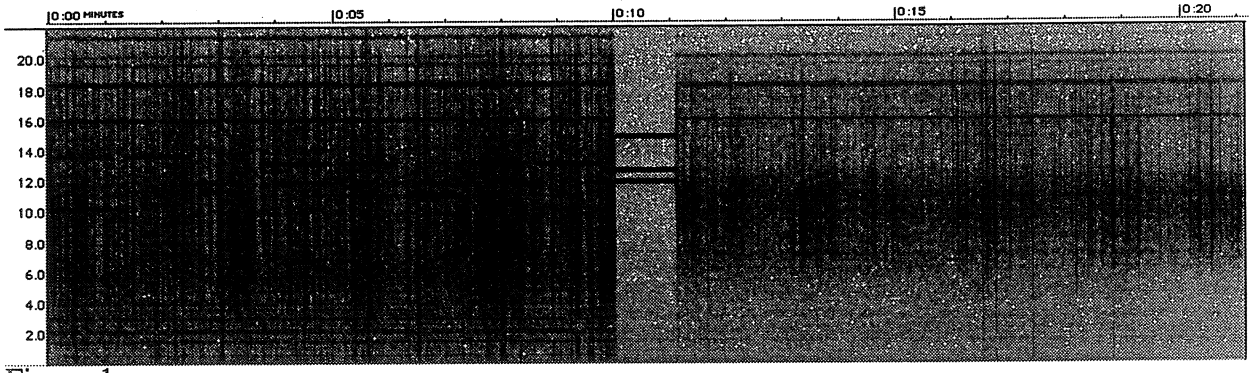


Figure 1.

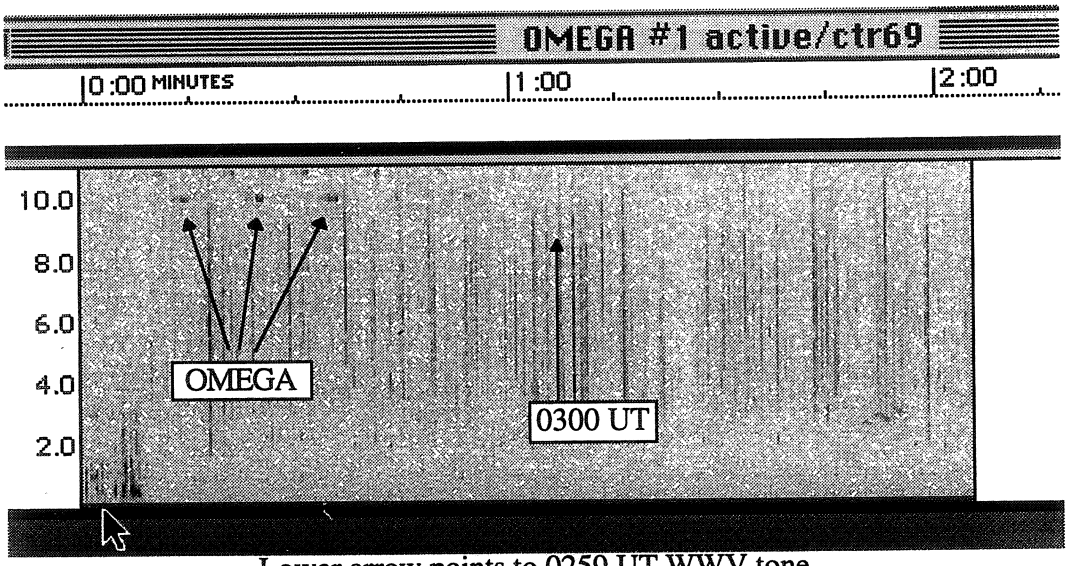
ALPHA

So what is ALPHA? It's a three station complex of VLF transmitters in Krasnodar, Novosibirsk, and Komsomolskamur, Russia that broadcast on 11.905, 12.649 and 14.881 kHz. It also was developed for radionavigation, but it is difficult to determine much information about it. Like OMEGA, it has operated for many years, and continues to do so. Our Russian INTMINS Leader, Stas Klimov of the Space Research Institute tells me that ALPHA is being used for basic radio physics research. Our European Coordinator, Flavio Gori, receives ALPHA regularly and tells me that the basic cycle of the transmissions is three segments of 3.6 seconds each. During the segments 1, 2, or three of the stations are transmitting. The pulse lengths are 0.4 seconds long, with 0.2 seconds or more between pulses. I had hoped that I would be able to see the ALPHA signals in Figure 1, but have not been able to, at least with confidence, so far.

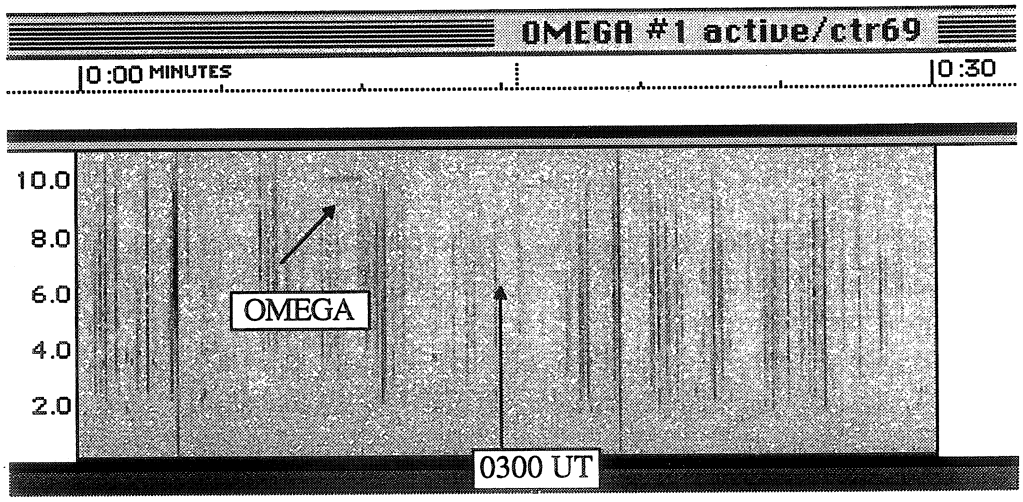
Chaffey High School Observes the OMEGA Shutdown

by Bill Pine
Chaffey High School
Ontario, California

On Monday evening, September 29, at 8:00 PM local time (0300 UT 30Sept97) Chaffey High School INSPIRE Team members were at our observing site in the mountains to record the shutdown of the OMEGA system. Below are some spectrograms of the time of the shutdown. OMEGA dashes are visible in each before 0300 UT, but the dashes disappear exactly on time. Student observers also reported that the cessation was audibly apparent as they listened.

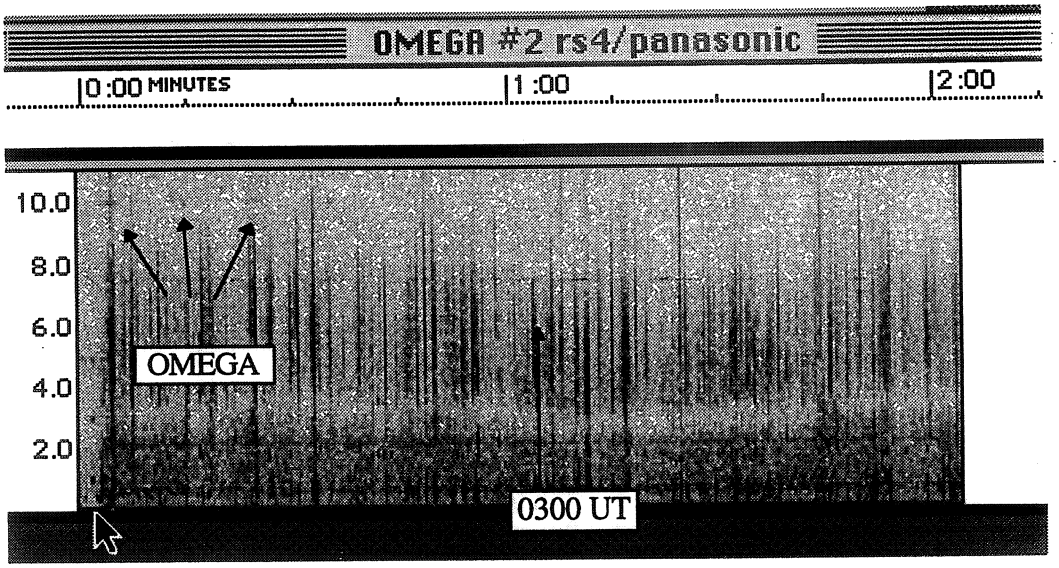


Lower arrow points to 0259 UT WWV tone.

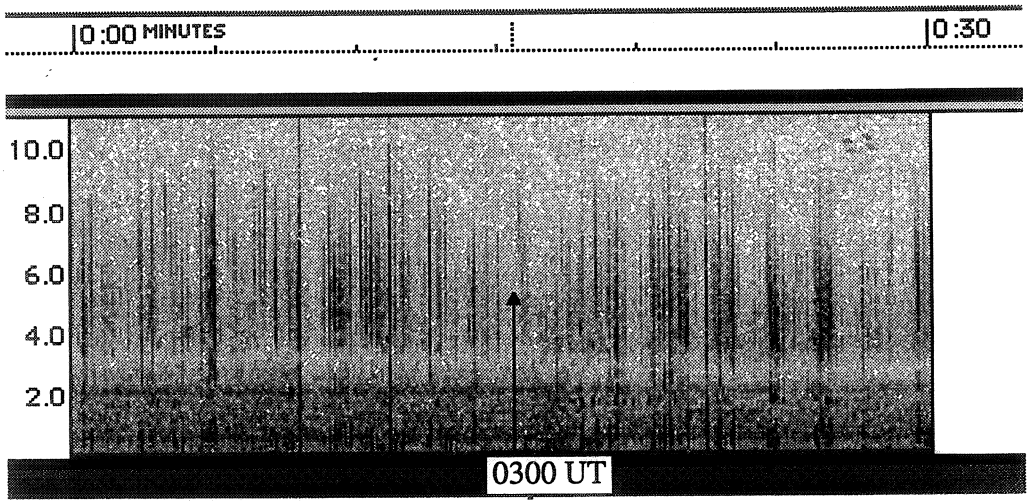


Eric Reed - ACTIVE receiver, RS CTR69 recorder

This is a B-field receiver that has been the most sensitive to OMEGA signals in the past. While VLF propagation conditions change constantly, there is some evidence that the shutdown was not abrupt, but rather involved a reduction in power over about 30 seconds.

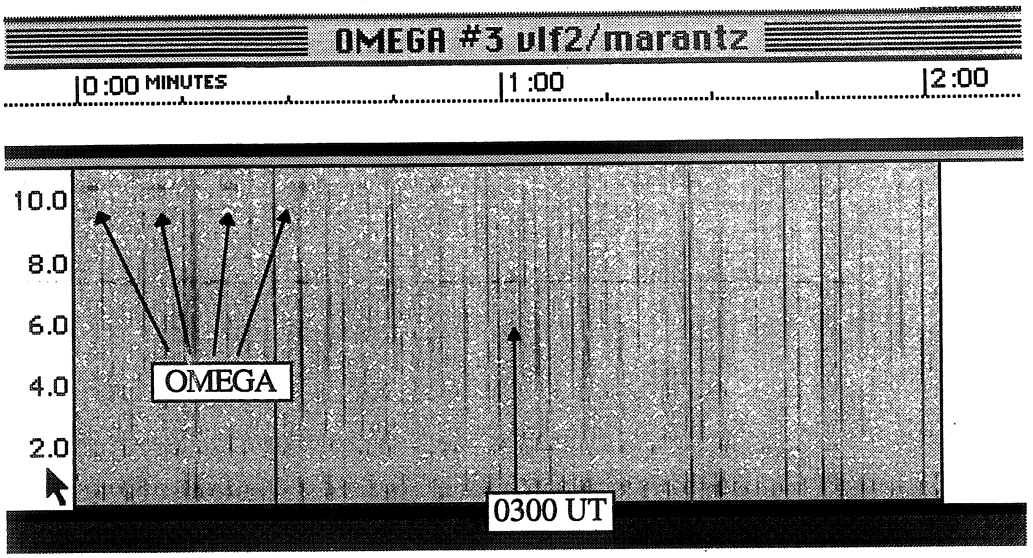


Lower arrow points to 0259 UT WWV tone.

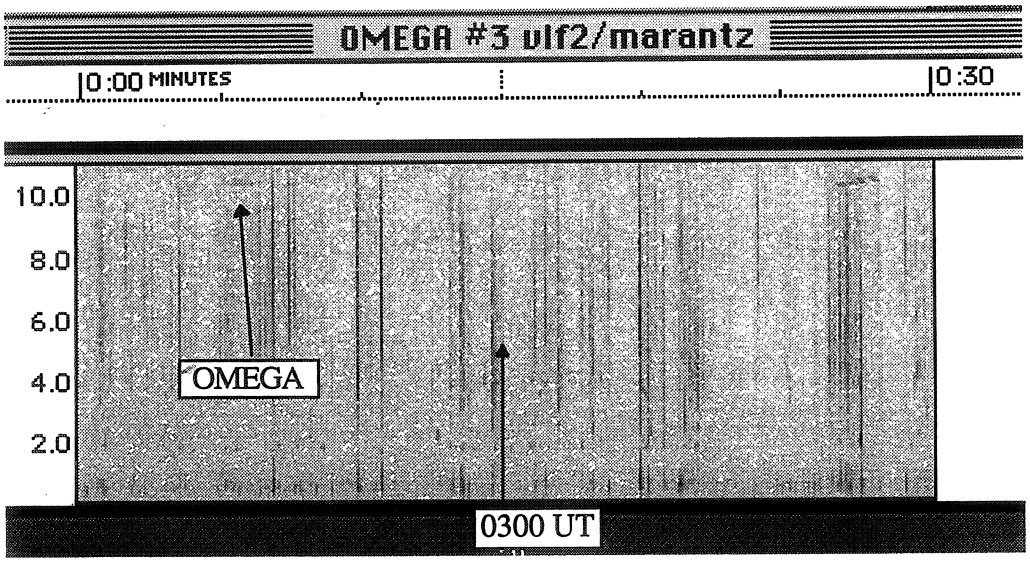


Maria George - RS4 receiver, Panasonic recorder

The RS4 receiver used for this observation was built by Chaffey students in 1993. The antenna is a telescoping 6 foot whip. The recorder is a 7-year old portable. This receiver is not usually sensitive to the OMEGA frequencies, but it did record some of the signals as shown. In the 30-second closeup, the OMEGA dashes are not apparent before 0300 UT.



The WWV tone was not picked up on this recorder, but the spectrogram starts at 0259 UT.



Megan Souter - VLF2 receiver, Marantz PMD430 recorder

The VLF2 receiver used here was built by Chaffey students in 1996. The Marantz recorder is the best recorder we use. The antenna is a 6-foot telescoping whip.

The students who went on this trip had been physics students for about 3 weeks, but they were eager to get involved in INSPIRE. Maria George, Megan Souter and Eric Reed did a good job making field observations for the first time - and in the dark! Fortunately the weather was good and it was a very pleasant evening.

As a data analyst, I will miss OMEGA. Since my high frequency hearing is not what it used to be, I was unable to hear OMEGA in the field. (This fact amused my students.) OMEGA was a friendly presence on spectrograms, providing reliable time information and a good indication that the receiver was working properly.

LOW FREQUENCY PEOPLE

By Flavio Gori
INSPIRE European Coordinator
Florence, Italy

I was involved in VLF/ULF radio frequency field since 1991, not really so long. Through this I have had the pleasure to meet, both in person that by letter, so many interesting people, that I never thought before they could even live. There are on this land people who really like to study and work just for the pleasure to discover something, following their wonderful spirit, to arrive where their heart wants to go. And this place is free from money. Yes, they do not search for money. They just look for research. They just want to know how this, our world, lives and works.

I believe these people are a big, very big, part of this Low Frequency world. I'm sure they could be a very important example for the young researchers in the INSPIRE Project, too.

Most of you know about the people who created INSPIRE and the other who usually write in this Journal and other newsletters dedicated to this radio range. They are very well known in the world-wide community.

This time I will take the opportunity to talk about a wonderful man who has done a very important job in this range. A man who has worked in the VLF/ULF range for most of his life: from 1959 as a contractor for the NASA Space Program until the first MARS VIKING Mission in 1975. Even a brief summary of his earlier space work would include the Gemini, Mercury, Apollo, Apollo-Soyuz and Viking projects! What a lot of experience! He has served in such very quiet sites as Ascension Island, a place where you can do VLF research with almost no background noise. Being very capable with electronics, he was (and is still) able to build for himself the devices he needs. As you can understand he's able to accomplish the good kind of design and handling with the very high knowledge of the theoretic side of the range.

Probably, at this point, you are wondering who ever he will be. His name is Mr Jim Stoughton, living in Seattle, WA. Does anybody know him? Dan Levit has written about him some times in his column dedicated to the Natural Radio Phenomena in "The Lowdown" newsletter (produced by the Long Wave Club of America). Very unfortunately the hard noise in Seattle does not permit any kind of VLF activity to Jim, though he is still very active producing interesting devices, useful for "our" research.

Back in '59 he was in Grand Bahamas, serving all nights from 0000 to 0800 in the morning at the big high power transmitter site. First at the Grand Bahamas GBI-03 transmitter site, then he became site RF system chief, and was responsible for all logistics, personnel training and Missions Operations of three different sites: radio transmitters/receivers, Apollo EME and Command Control/Destruct range safety site. Grand Bahamas Islands being one of the great thunderstorm sites in the world, he also did much research on lightning as well as VLF work. His job was as an RCA International worker, a second contractor for NASA.

He reports about the wonderful Ascension Island time: a paradise for VLF and also for sun and sea lovers. (They had to stay very alert for the big fish going around, also near the beach.) So the time there is not just for research, though not so easy, so far away from anything. In Ascension, Jim could track also some interesting phenomena such as missile re-entries coming into the atmosphere from space at great velocities. After some Columbia University VLF scientists came there to investigate about distant missile lift-off signatures left in the atmosphere, Jim built his own gear and indeed verified disturbances in the VLF range. Maybe you remember a similar research made by some USA scientists headed by Dr Jack Dea in San Diego, in the 80's. This is a very interesting research which probably started in the '60s

from an idea of an Italian researcher, Dr. Mario Grossi, who lives in the USA and actually works at Harvard University:

The space vehicle reentry signs can be detected in the radio spectrum below 15 Hz, so this requires an important antenna system, very accurate. Possibly you have to invest many hours to get the best from the system. This is what one friend of mine and me have done last winter, though we could not go down below 14/15 kHz. We need more turns. Many more turns. Of course we have faced some problems connected with hum-noise, also the computer noise. In a professional lab, here in Firenze, we are trying to get closer to those frequencies, thanks to important collaborations. I'll keep you posted.

As you can understand also in these few words, Jim's life has been really fascinating. In the present days he is still well involved in the VLF radio range and from Seattle he is in tune with some people involved in this side of radio science. His NATURAL RADIO LAB, which is located just at his home, is able to build fascinating analog devices such as

- Rhiometer (very able to detect space VLF radio waves);
- T-Storm/Solar activity monitor;
- Simple spheric/T-Storm monitor;
- Combo photon/IR level meter;
- Volt auto electrical system Analyzer,

just to list a few. I have purchased these items and they just arrived at my home. As soon as possible I'll begin to work them and let you know how they work. I am sure these devices will be perfect. One more of Jim's devices is a GRAVITY WAVE DETECTOR: it will be the next for me.

All of these are items will let us understand a little bit more of the secrets of our Earth and the atmosphere surrounding all of us. Jim's instruments give us a way to investigate our physical world in more depth. They give us a way to understand, by our field sessions, how the Earth lives and works and which kind of research could be more useful for our minds.

These kinds of instruments are a real dream come true for a curious spirit like mine (and I'm sure like yours). People involved in a field research such as VLF/ULF radio waves have to be interested in all the kind of scientific research, especially if connected to very low frequency radio waves. God only knows how many there are.

I think Jim has a wonderful way to spend the "autumn years of life", as Jim called his time now. Ham people have to continue to try not to become just push-button men, like some I know, in these lazy years. Here in Europe, and probably in the USA too, many hams (and not only hams) are becoming lazier and lazier, like people only TV watching. They prefer to look at television (sometimes not understanding and not seeing, too), avoiding letting the brain work on some problems incidental to radio waves propagation, or building devices, or any other kind of design and work.

This is probably not a good way to go in to the future and the young people should be warned about this risk, for their future life. The same risk is very present for the older people, who probably should stay well in tune with the new and old things, if they continue to use their mind. In this way we'll enter in the future in a better shape, not only for our body!

The very wonderful world we can experienced in these years is not enough. We have to catch the many opportunities we see in front of us. We have to keep our eyes very open so we don't spoil all these opportunities. In a time rich with important and brand new items we are risking not profiting from these opportunities while driving our brains in a closed road.

Jim Stoughton gives us a hand. We should be awake enough to take it.

INTMINS OBSERVERS

Roster Update

The following is a roster of INTMINS observers including first-time observers. Team number assignments are permanent and will be used to refer to teams in the future.

North American observers:

Team #	Observer	Location
1	John Lamb, Jr. East Texas State University (Retired)	Belton, TX
2	Stephen G. Davis	Fort Edwards, NY
3	Don Shockey	Oklahoma City, OK
4	Mike Aiello	Croton, NY
5	Jean-Claude Touzin	St. Vital, QC, CANADA
6	Bill Pine Chaffey High School	Ontario, CA
7	Dean Knight Sonoma Valley High School	Sonoma, CA
8	Mike Dormann	Seattle, WA
9	Robert Moloch Eastern Elementary School	Greentown, IN
10	Bill Taylor INSPIRE	Washington, DC
11	Mark Mueller Brown Deer High School	Brown Deer, WI
12	Jon Wallace	Litchfield, CT
13	Bill Combs	Crawfordsville, IN
14	John Barry Seeger High School	West Lebanon, IN
15	Robert Bennett	Las Cruces, NM
16	Leonard Marraccini	Finleyville, PA
17	Kent Gardner	Fullerton, CA
18.	David Jones	Columbus, GA
19.	Larry Kramer / Clifton Lasky	Fresno, CA
20.	Barry S. Riehle Turpin High School	Cincinnati, OH
21.	Phil Hartzell	Aurora, NE

European observers:

Team #	Observer	Location
E1	Flavio Gori	Florence, IT
E2	Silvio Bernocco	Vaccera, IT
E3	Fabio Courmoz	Aosta, IT
E4	Joe Banks	London, UK
E5	Renato Romero	Cumiana, IT
E6	Marco Ibridi	Finale E., IT
E7	Alessandro Arrighi	Firenze, IT
E8	Zeljko Andreic Rudjer Boskovic Institute	Zagreb, Croatia
E9.	Dr. Valery Korepanov Lviv Center of Institute of Space Research of NASU	Lviv, UKRAINE

Additions to the roster of INTMINS Observers:

New INTMINS teams, with their permanent team numbers and descriptions are shown below. INTMINS observers are described in the following format:

X. (team number) Name of observer Location
Team Name
Longitude: of observation site
Latitude: of observation site
Description of observation site
Receiver: description of receiver used
Recorder: description of recorder used
Antenna: antenna type and description
WWV: WWV radio used (if any)
File code: used for naming data files for storage

North American Teams:

22. Rick Campbell Brighton, MI

Longitude: 83° 50' 2.7" W
Latitude: 42° 16' 43.7" N
Open field near golf course
Receiver: Homebrew RS4
Recorder: Radio Shack 14-1158
Antenna: 6' whip
WWV: Radio Shack DX-440
File code: CAMPBELL MI

23. Jim Ericson — Glacier, WA

Longitude:	121° 57.91' W
Latitude:	48° 53.57' N
Receiver:	WR-3
Recorder:	Sony DAT Portable (TCD-D7)
Antenna:	50' horizontal wire extended up 30'
WWV:	Radio Shack Time-Weather Cube
File code:	ERICSON WA

24. Paul DeVoe — Redlands, CA

Redlands High School

Longitude:	116° 52' W
Latitude:	34° 10' N
Jenks Lake	
Receiver:	INSPIRE RS4
Recorder:	
Antenna:	whip
WWV:	
File code:	DEVOE CA

European teams:

E10. Sarah Dunkin — London, England

University College London

Longitude:	0° 02' E
Latitude:	51° 40' N
Cleared area on edge of forest.	
Receiver:	INSPIRE RS4
Recorder:	Mono recorder
Antenna:	4 meter wire
WWV:	
File code:	DUNKIN UK

INTMINS - April/97
Data Analysis Report

by Bill Pine
Chaffey High School
Ontario, CA

The April/97 INTMINS observations marked the fifth session in an ongoing series of operations conducted with the cooperation and assistance of the Russian Space Agency (IKI) and ENERGIA, the Russian space engineering organization. INTMINS is an attempt to detect manmade VLF radio waves emitted by instruments on the MIR Space Station.

INTMINS Status Report

After analyzing data tapes for the latest INTMINS operations, the 1 kHz signal from ISTOCHNIK still has not been detected. The current plan is to continue the twice-annual observing sessions as we have done in the past.

Occasionally we get telemetry reports from MIR which indicate when the instruments operate to allow us to see if they operated and if the operation was on schedule. Telemetry from the April operations indicates that ARIEL operated as scheduled. ISTOCHNIK, however, did not operates for passes 26-1, 26-2, 26-3, 26-4, 26-5 and 27-2.

There has been a very positive result from our efforts and it is obvious to the data analyst: without exception every observer is getting better and better at all aspects of the procedure. This cannot help but increase the odds of detection at some later date.

Data Analysis Procedure

The data analysis procedure used this time consisted of the following:

1. A sound file was created of the 2-minute period of ISTOCHNIK operation.

2. A spectrogram image was made of this file using a frequency range of 0-11.025 kilohertz. The 1 kilohertz region of the spectrogram was examined for the 10 seconds on, 10 seconds off signal from ISTOCHNIK.

3. A one-minute portion of the file was cropped, enlarged and an image made. Again the 1 kilohertz region of the spectrograph was examined.

4. Finally, a 30-second portion was cropped, enlarged and an image made. A final examination of the 1 kilohertz region was made.

5. Additional sound files and spectrogram images were made of items of interest noted in the logs.

INTMINS-April/97 Opertions Summary

(NOTE: All times are UT on the date indicated.)

European Passes

Pass	ISTOCHNIK Start Time	Path during ISTOCHNIK Firing	Number of Observers Recording Data
E20-4	1340	Northern Italy	2
E20-5	1520	Russia, South of Moscow	1
E20-6	1650	Southern England	2
E28-1	1040	Northern Italy	4
E28-2	1221	Russia, South of Moscow	2
E28-3	1350	Southern England	2

North American Passes

Pass	ISTOCHNIK Start Time	Path during ISTOCHNIK Firing	Number of Observers Recording Data
19-1	0059	Quebec	3
19-2	0234	MN, WI, MI	3
19-3	0405	WA, OR	2
19-4	1912	VA, DC, MD, DE	0
19-5	2353	WA	1
20-1	0135	MN, WI, MI	2
20-2	0312	NE, KS, OK, AR	4
20-3	0443	No. CA, So. NV	4
20-7	1812	East of NC, VA and DC	0
20-8	1943	Sw. TX, OK	4
20-9	2117	So. CA, NV	5
26-1	0035	MS, AL, GA	2
26-2	0208	Se. AZ, NM, So. central TX	1
26-3	1705	So. TX, LA, AR	3
26-4	1838	So. CA, NV, So. UT	3
26-5	2023	Quebec	3
26-6	2335	IA, IL, IN	1
27-1	1612	VA, DC, MD, DE	1
27-2	1746	So. MN, WI, No. MI	0

Summary of European Passes Recorded

Team/Pass	E20-4	E20-5	E20-6	E28-1	E28-2	E28-3
E2	x			x		
E3					x	
E5	x	x	x	x		x
E6				x		
E10			x	x	x	x

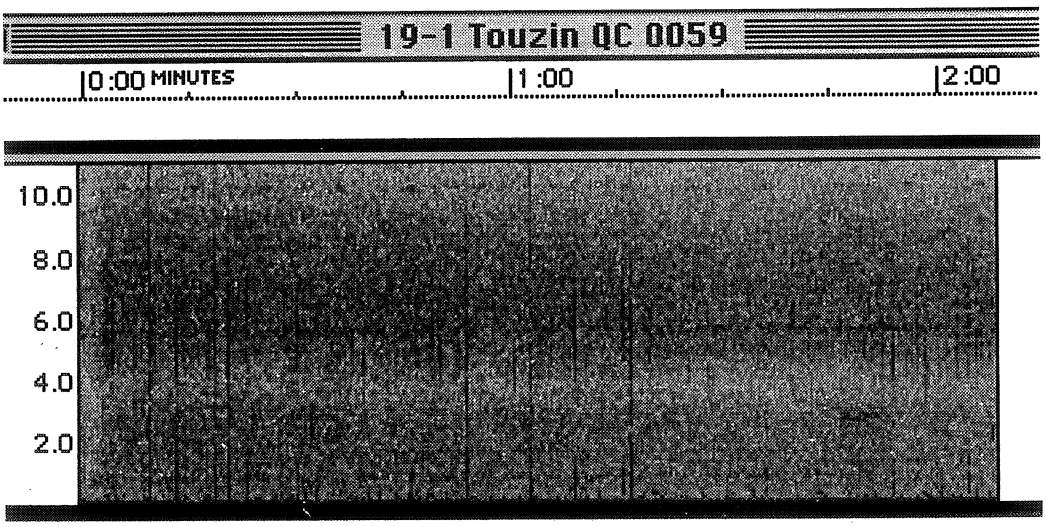
Summary of North American Passes Recorded

Pass	4/19					4/20						4/26						4/27	
Team	1	2	3	4	5	1	2	3	7	8	9	1	2	3	4	5	6	1	2
1										x				x					
3							x			x									
5	x															x			
6								x			x				x				
7								x			x								
8			x																
11																	x		
13							x							x					
15	x	x	x			x	x	x		x		x	x	x		x			
16																x		x	
18												x							
19								x			x								
21		x					x			x									
22	x	x				x													
23					x														
24											x				x				

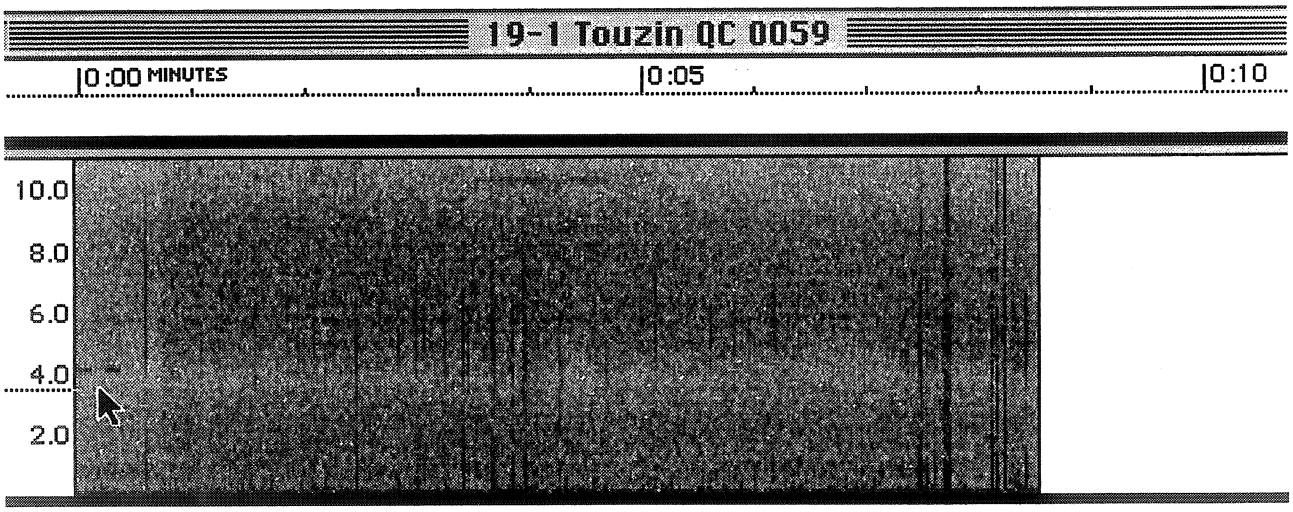
INTMINS Data

The following spectrograms are taken from data tapes submitted by INSPIRE observers. The first view shown will be that of the entire two-minute interval analyzed. At the top of the image is the sound filename which consists of the operation number, the name of the observer, the state or country where the observations were made and the start time of the operation. Subsequent views will be of portions of the first. Use the time scale at the top to determine the length of the view. Unless otherwise noted, the start time of the cropped view is the same as the start time of the operation.

19-1

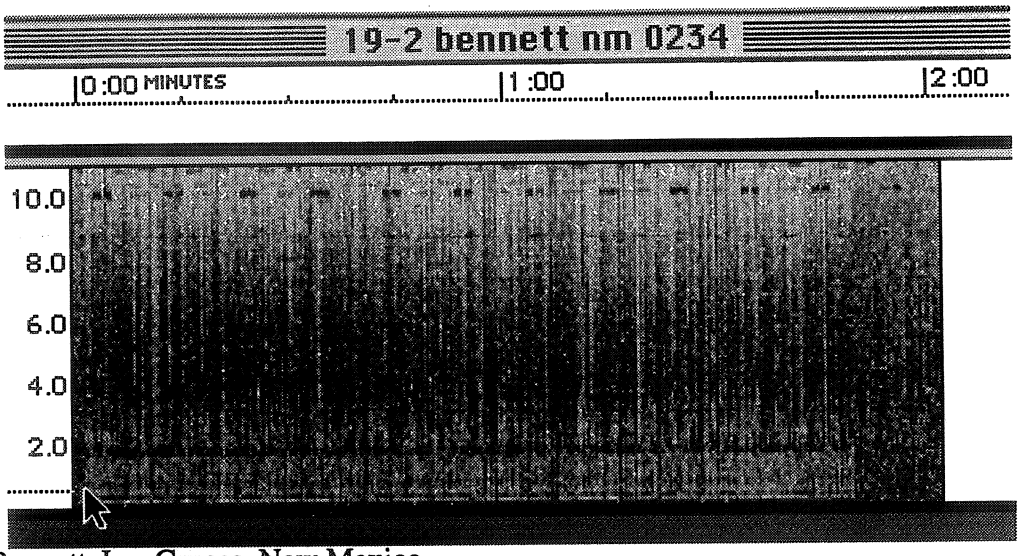


Jean-Claude Touzin, St. Vital, Quebec, Canada. Fairly quiet conditions with some strong sferics and OMEGA present.

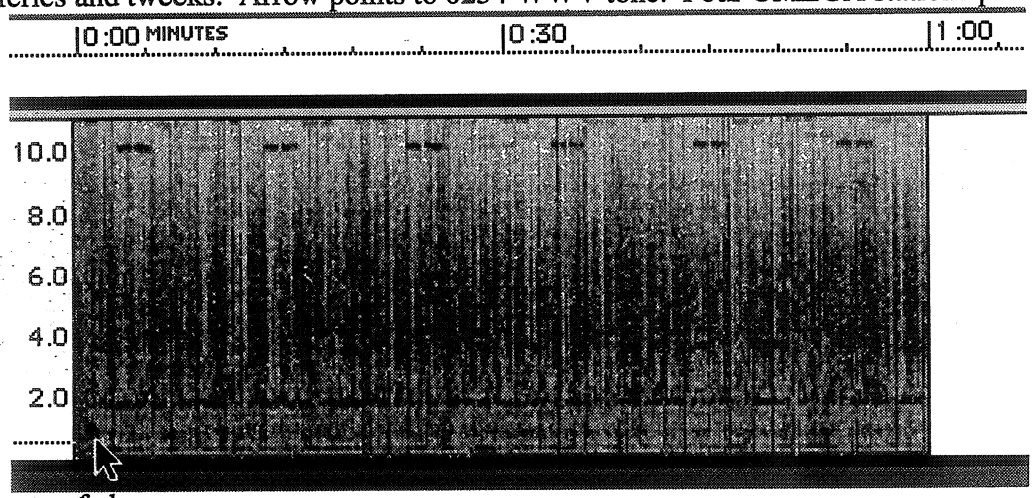


A ten second interval of the file. The arrow points to the double beep used as a time mark at 0059. Note the OMEGA dash at 0:04 seconds.

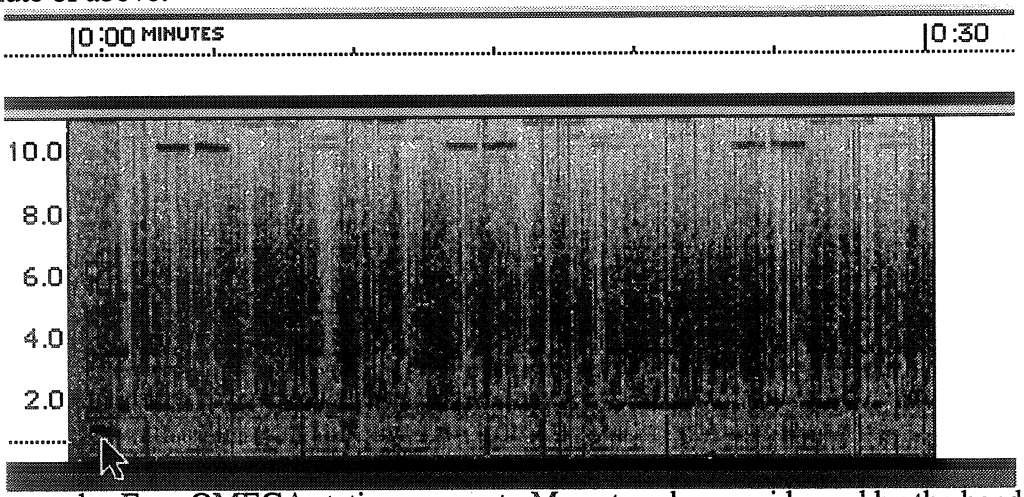
19-2



Robert Bennett, Las Cruces, New Mexico
Dense sferics and tweeks. Arrow points to 0234 WWV tone. Four OMEGA stations present.

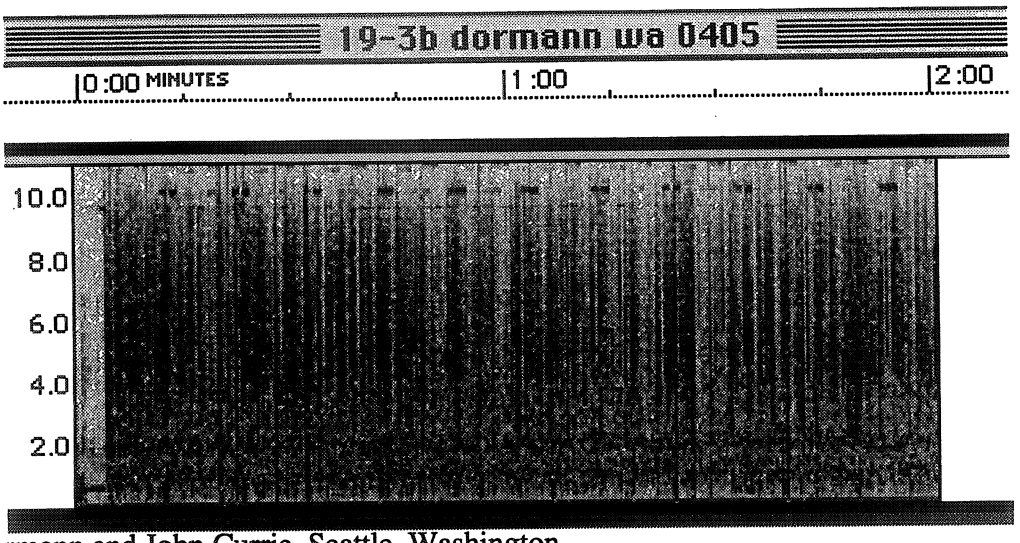


First minute of above.

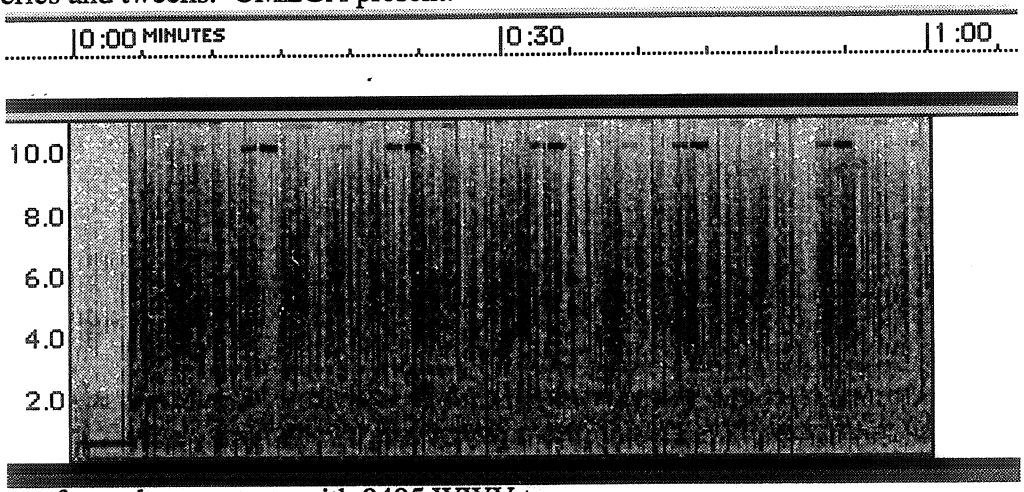


First 30 seconds. Four OMEGA stations present. Many tweeks as evidenced by the band of hooks at about 2 kHz.

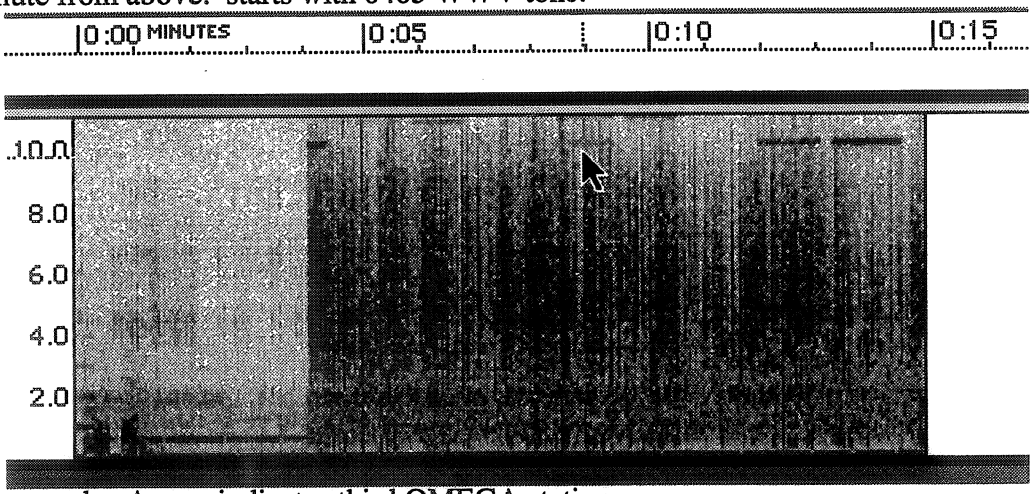
19-3



Mike Dormann and John Currie, Seattle, Washington
Dense sferics and tweeks. OMEGA present.

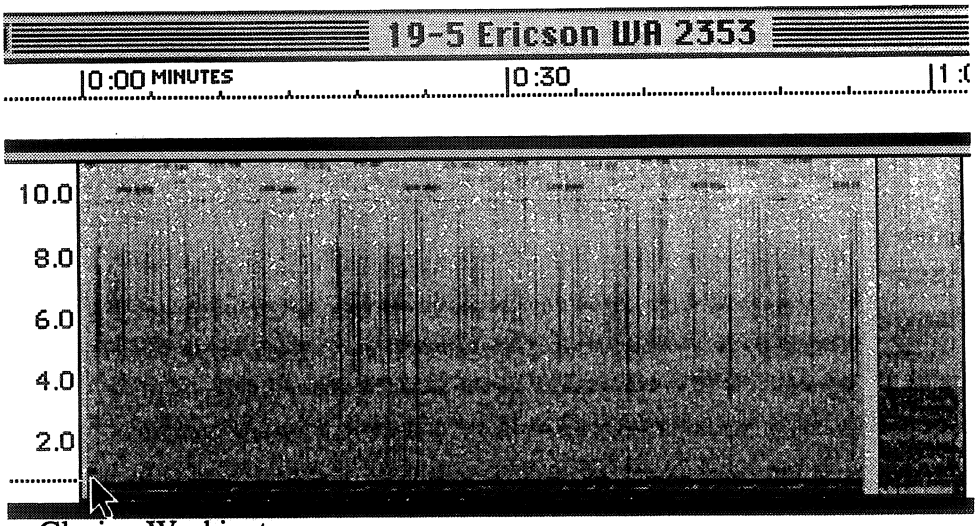


First minute from above. starts with 0405 WWV tone.

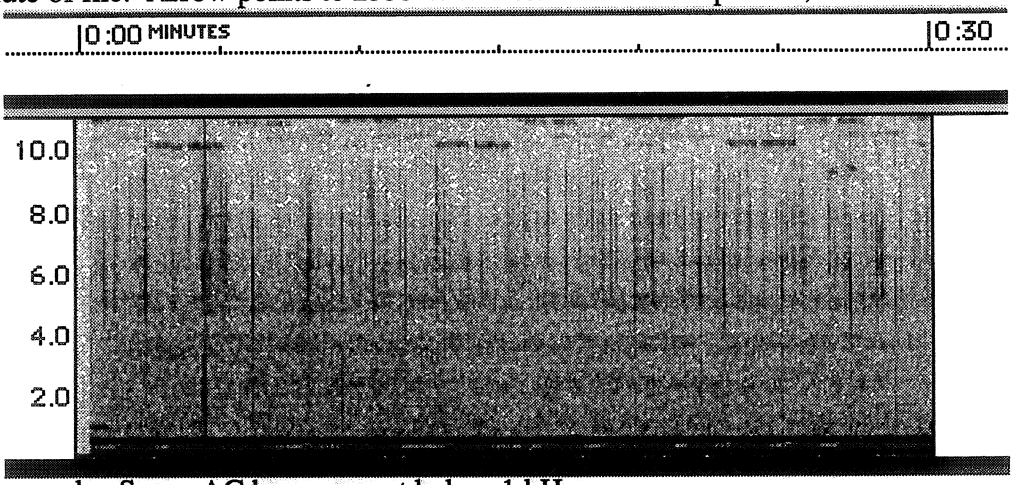


First 15 seconds. Arrow indicates third OMEGA station.

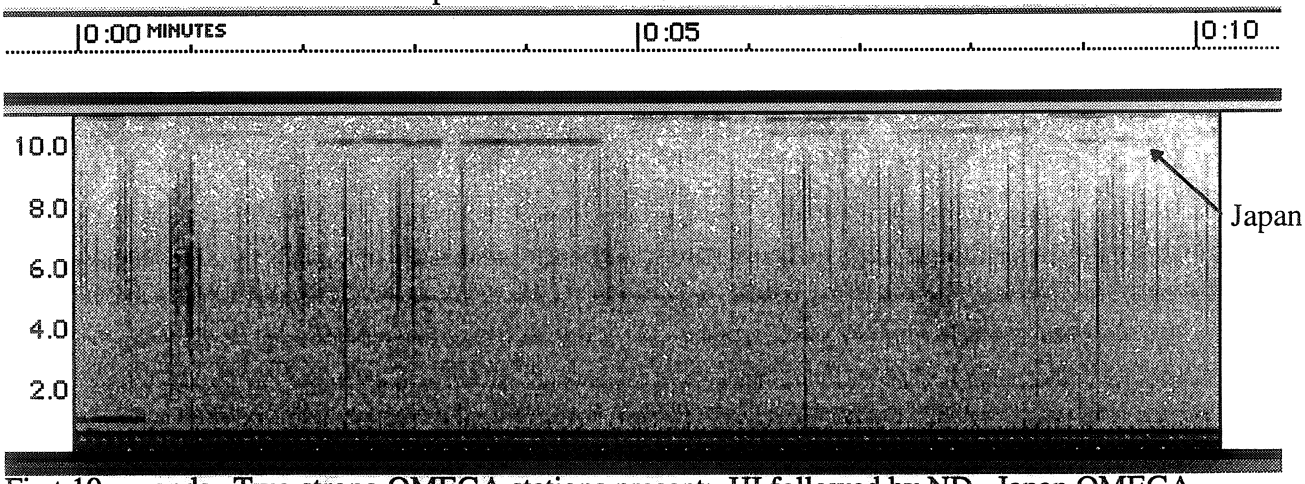
19-5



Jim Ericson, Glacier, Washington
First minute of file. Arrow points to 2353 WWV tone. OMEGA present, sferics.

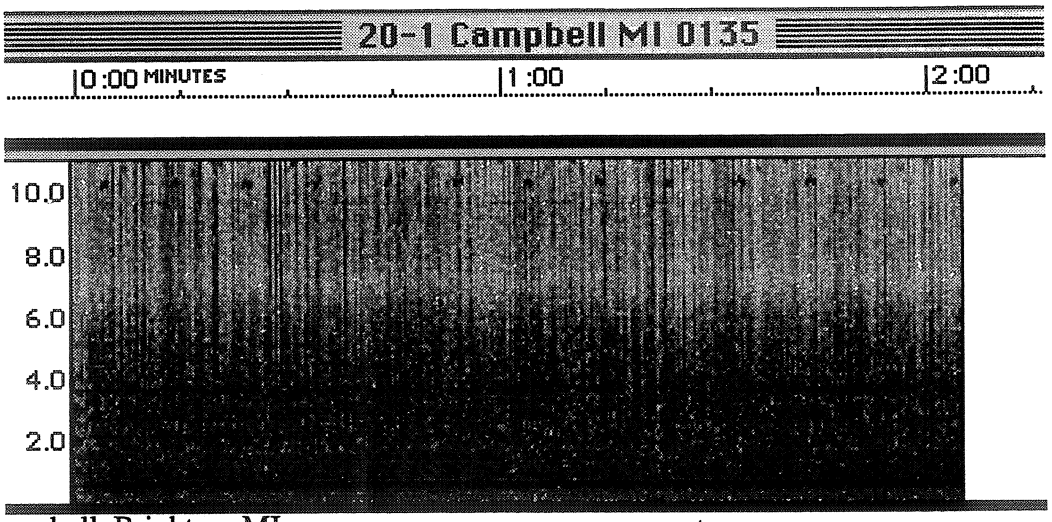


First 30 seconds. Some AC hum present below 1 kHz.

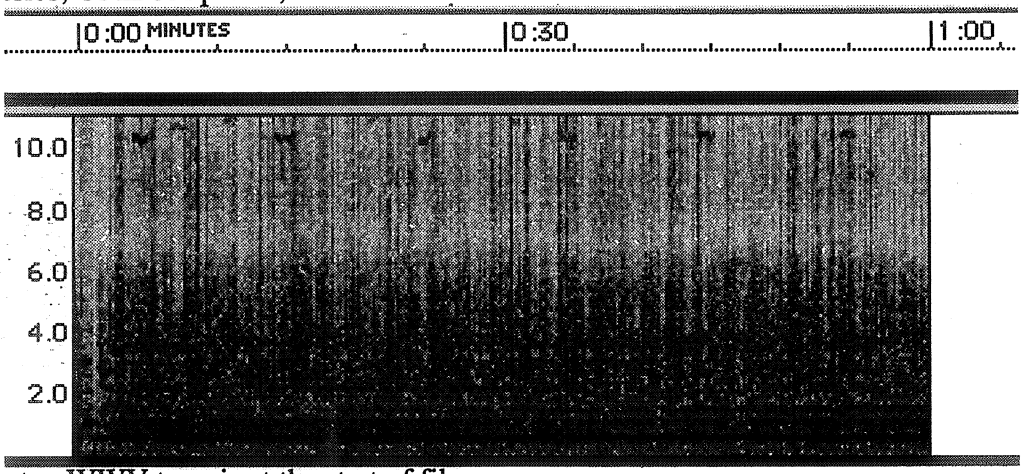


First 10 seconds. Two strong OMEGA stations present: HI followed by ND. Japan OMEGA station shows up at :09 seconds.

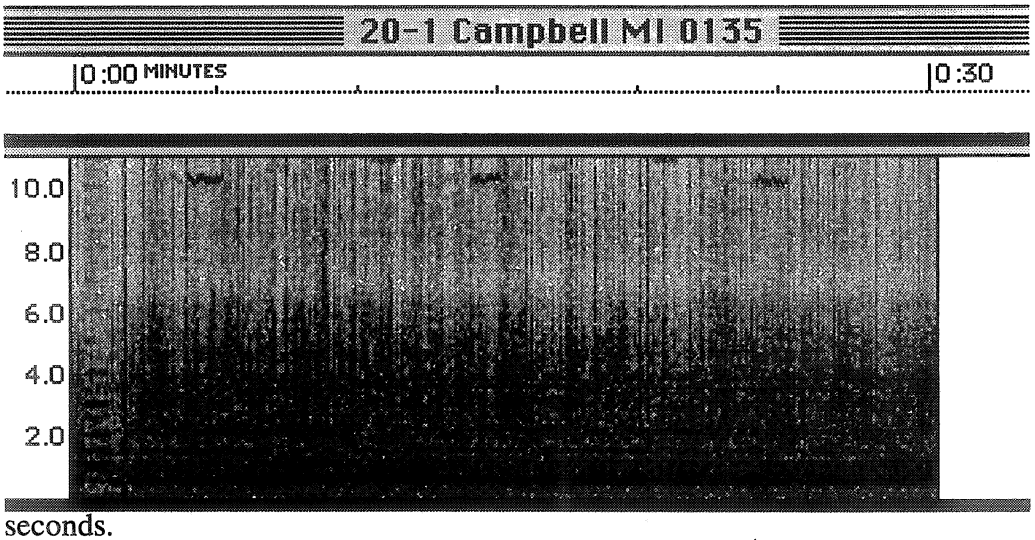
20-1



Rick Campbell, Brighton, MI
Dense sferics, OMEGA prsent, some AC hum.

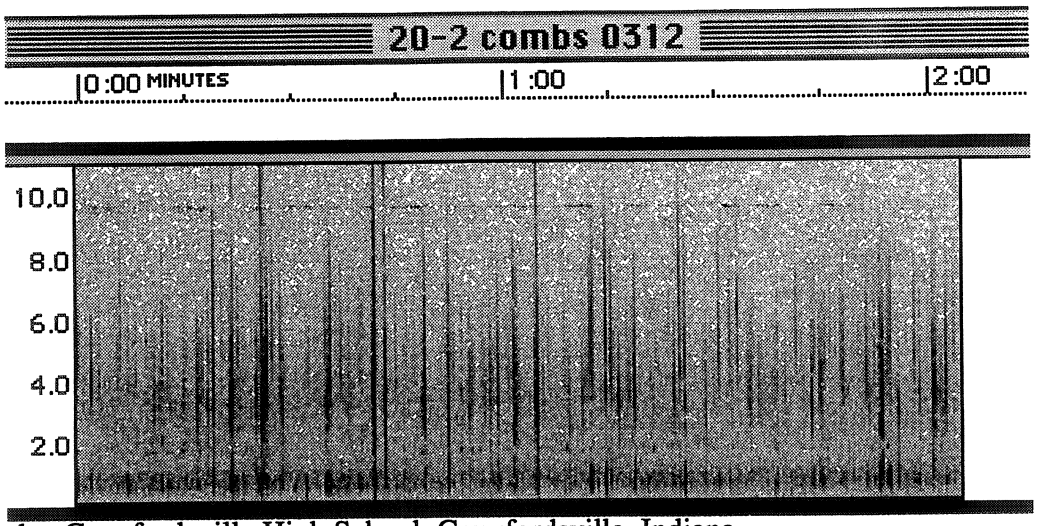


First minute. WWV tone is at the start of file.

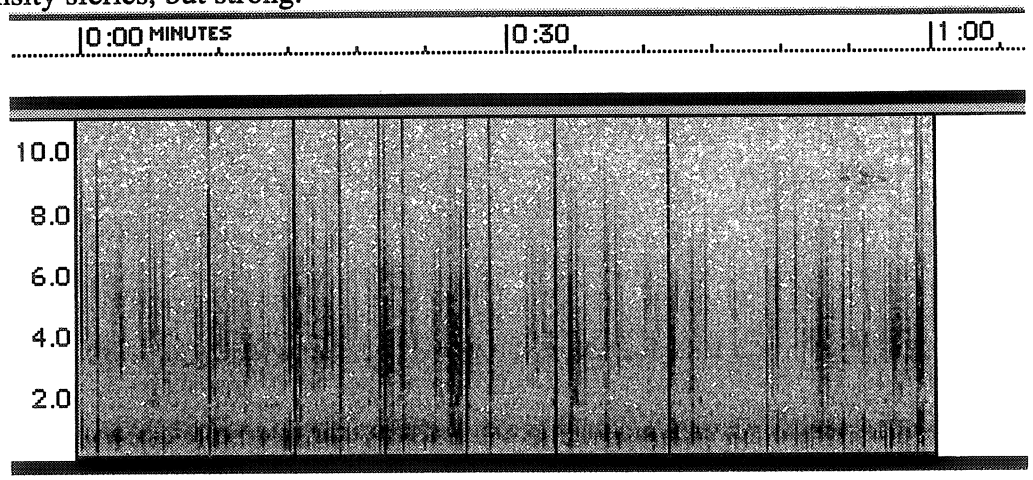


First 30 seconds.

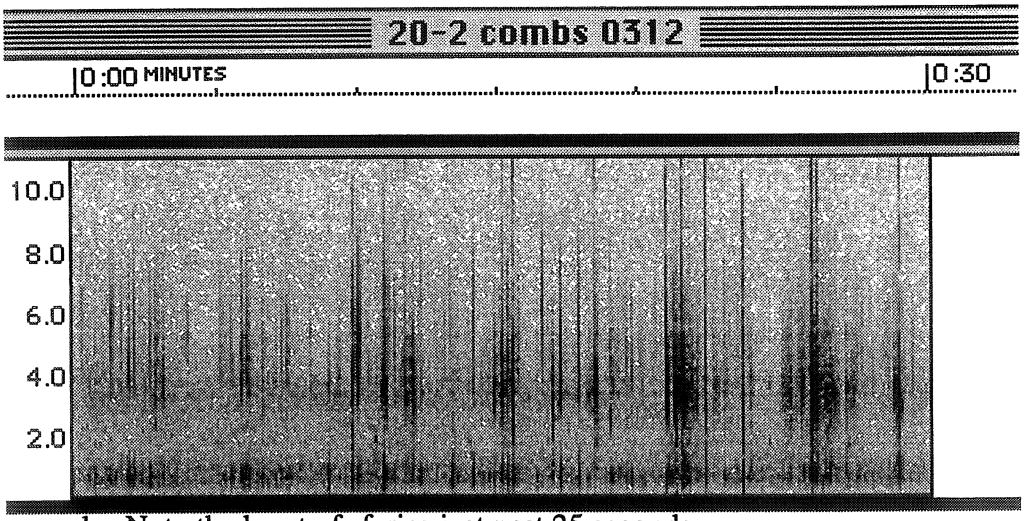
20-2



Bill Combs, Crawfordsville High School, Crawfordsville, Indiana
Low density sferics, but strong.

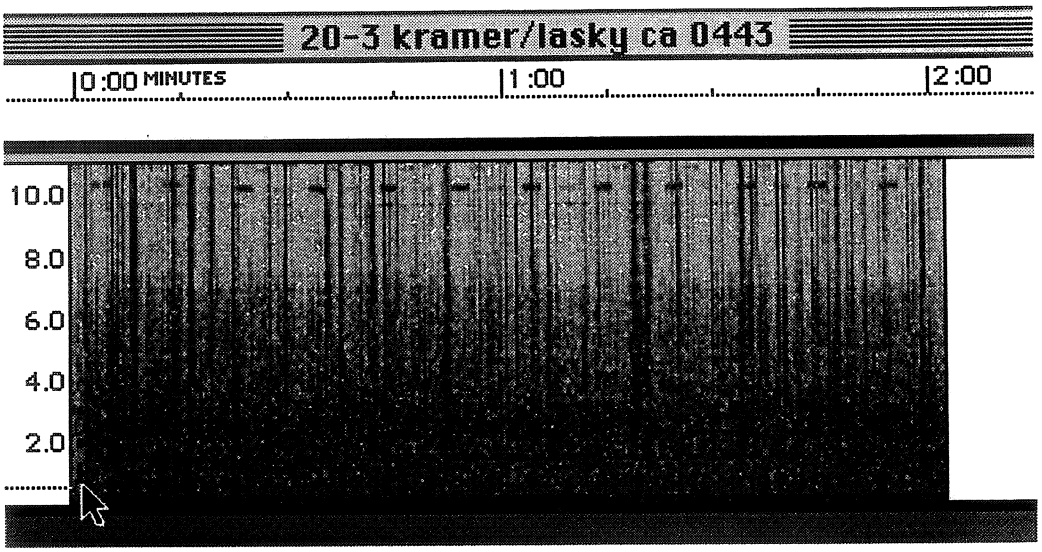


First minute.

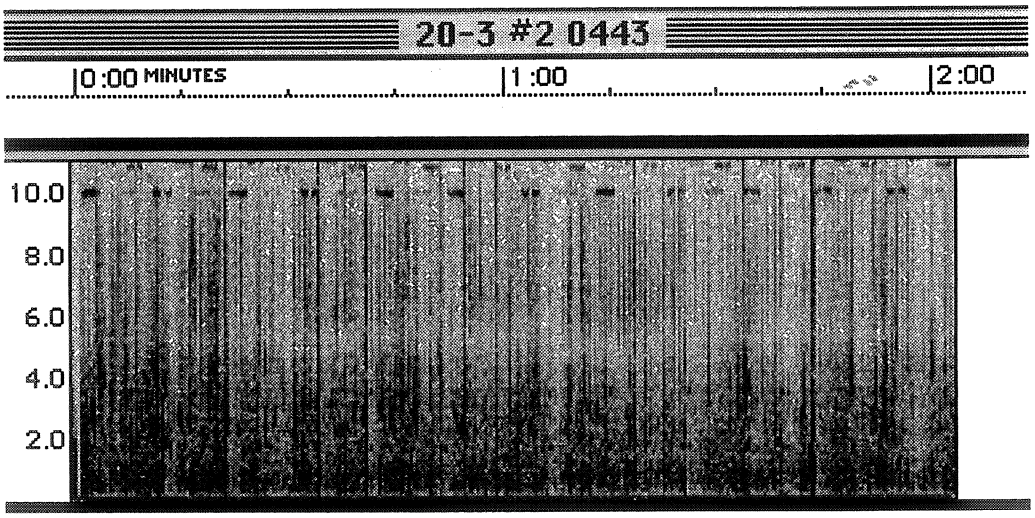


First 30 seconds. Note the burst of sferics just past 25 seconds.

20-3

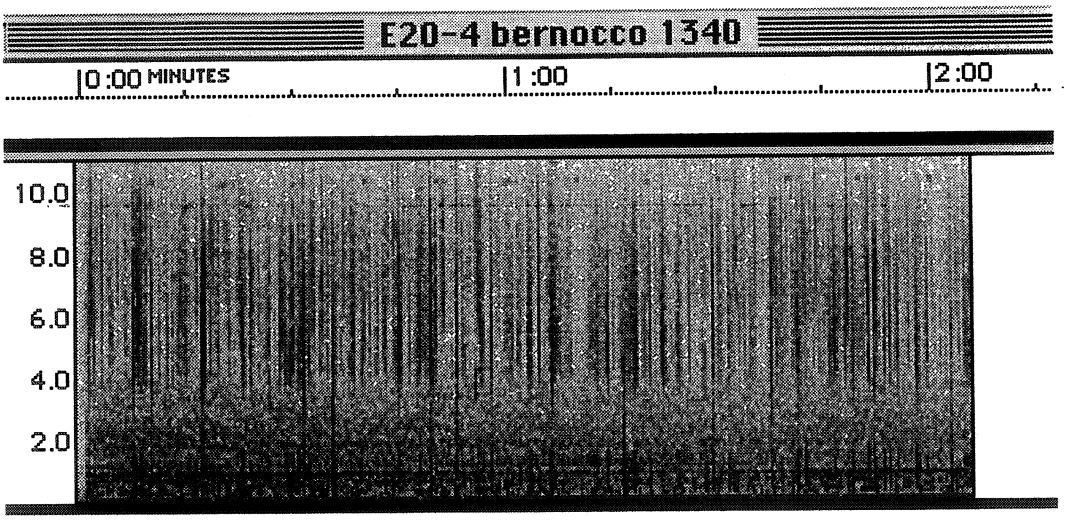


Clifton Lasky and Larry Kramer, Fresno, California
Dense sferics and tweeks, strong OMEGA, arrow points to 0443 WWV tone.

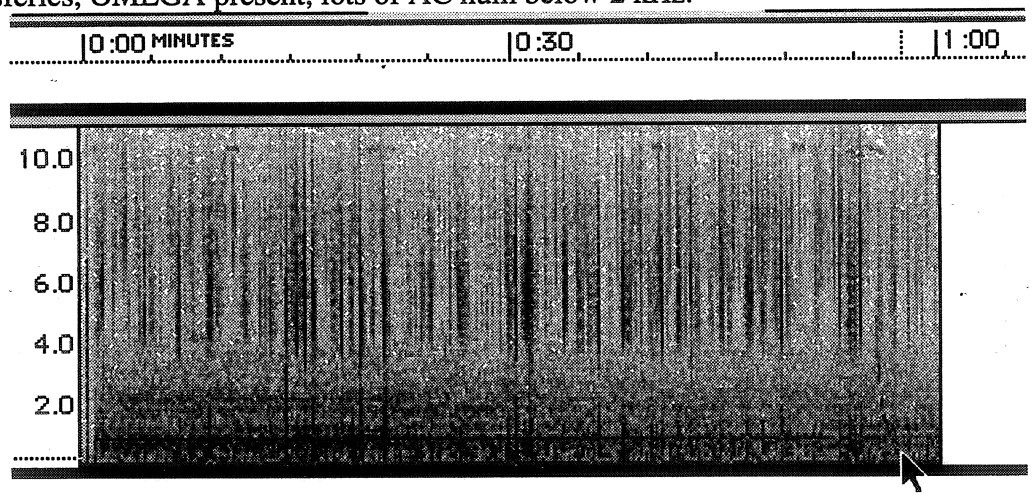


Bill Pine, Chaffey High School, Ontario, California
This data gathered about 250 miles south of the Fresno team.

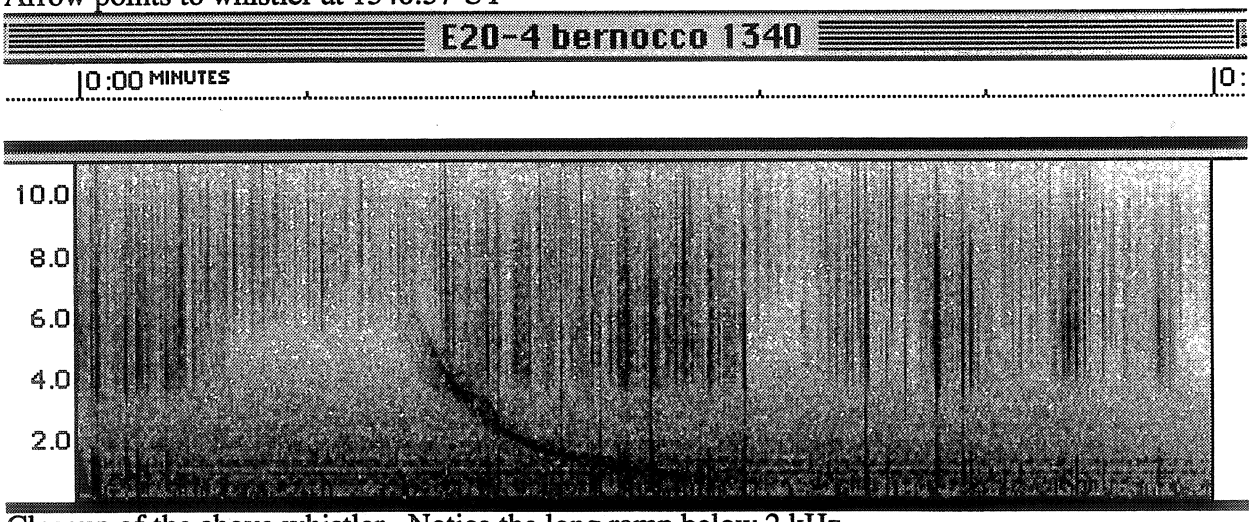
E20-4



Silvio Bernocco, Torino, Italy
Strong sferics, OMEGA present, lots of AC hum below 2 kHz.

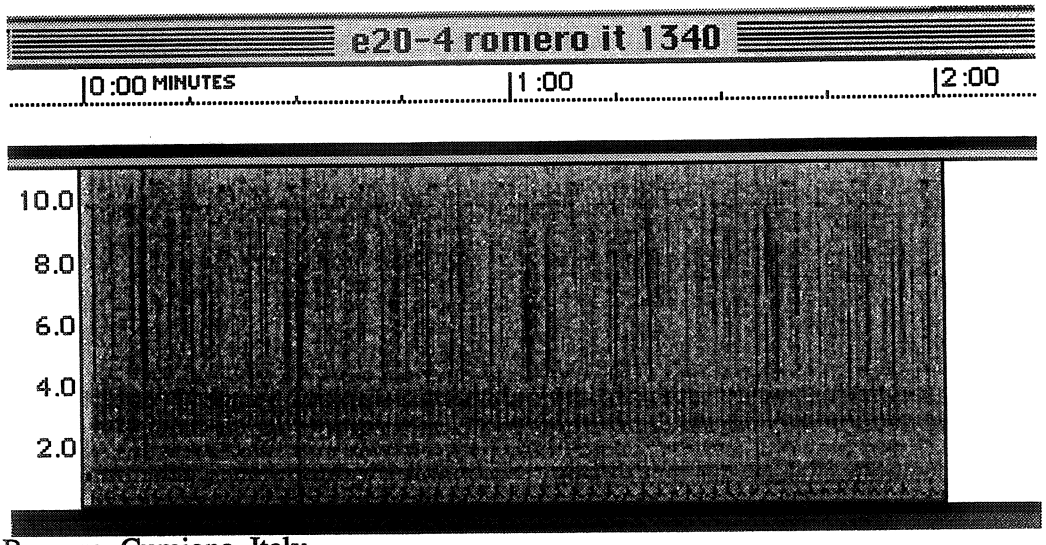


Arrow points to whistler at 1340:57 UT

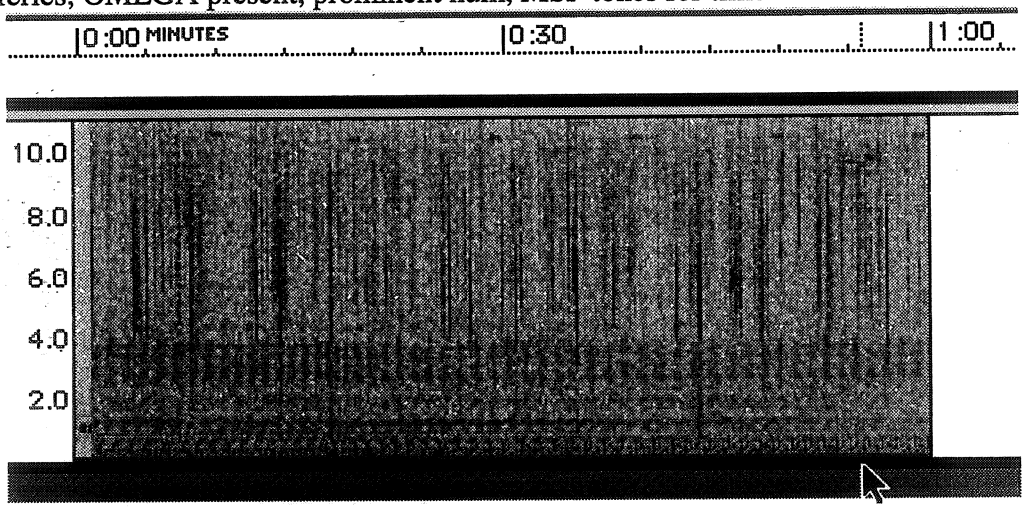


Closeup of the above whistler. Notice the long ramp below 2 kHz.

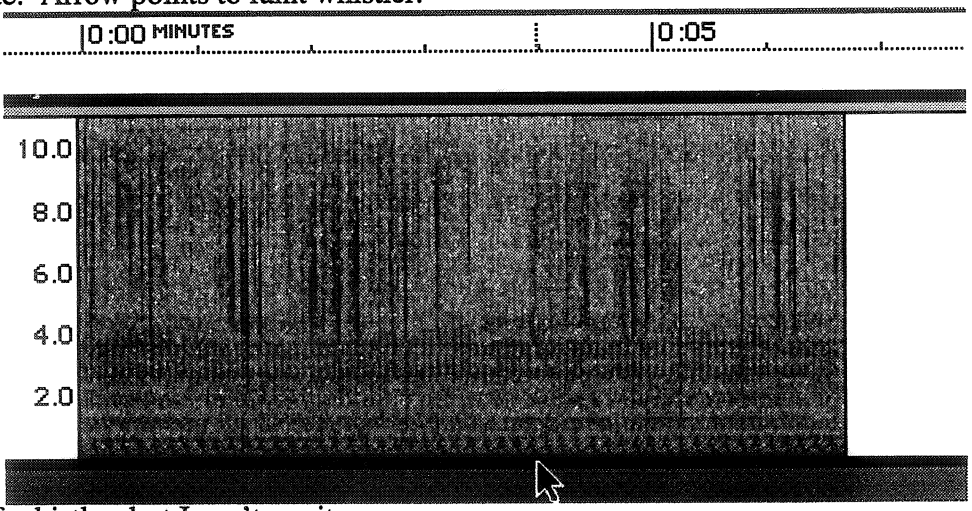
E20-5



Renato Romero, Cumiana, Italy
Strong sferics, OMEGA present, prominent hum, MSF tones for time mark at start.

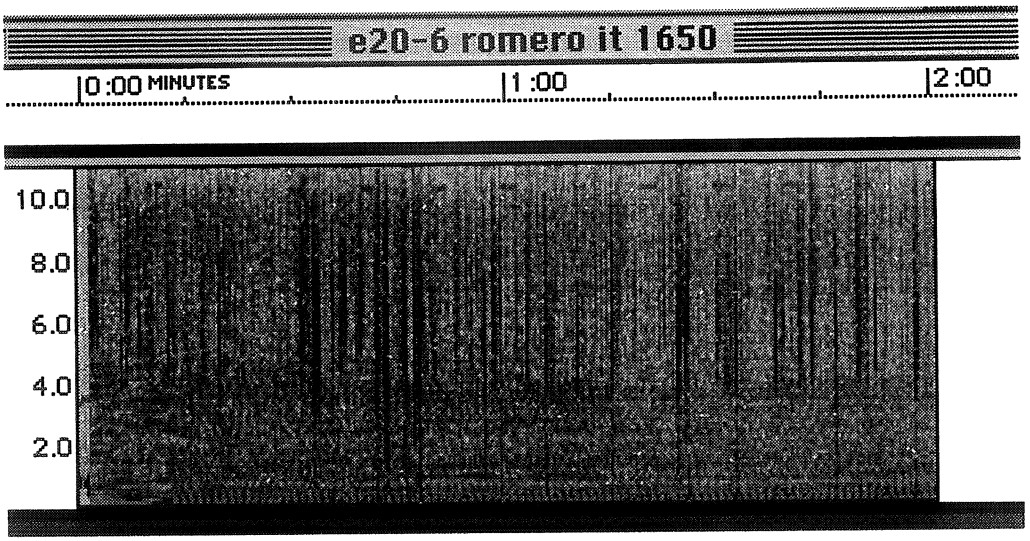


First minute. Arrow points to faint whistler.

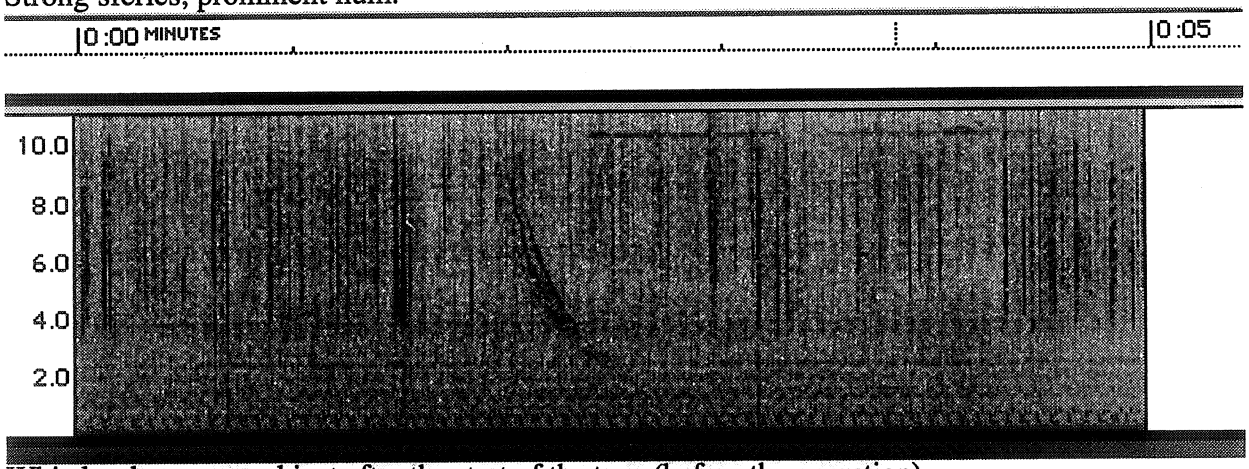


Closeup of whistler, but I can't see it.

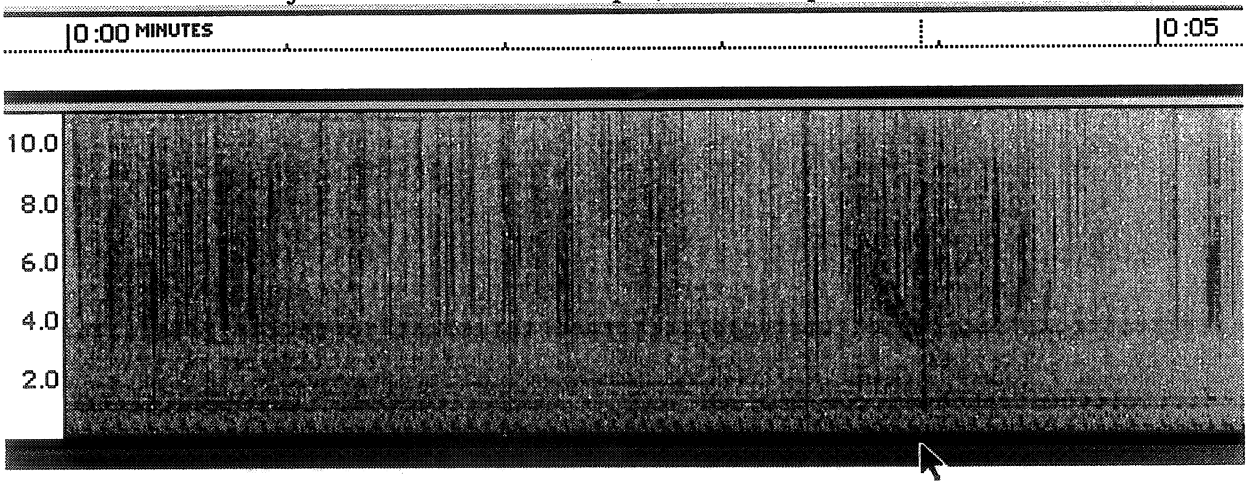
E20-6



Renato Romero, Cumiana, Italy
Strong sferics, prominent hum.

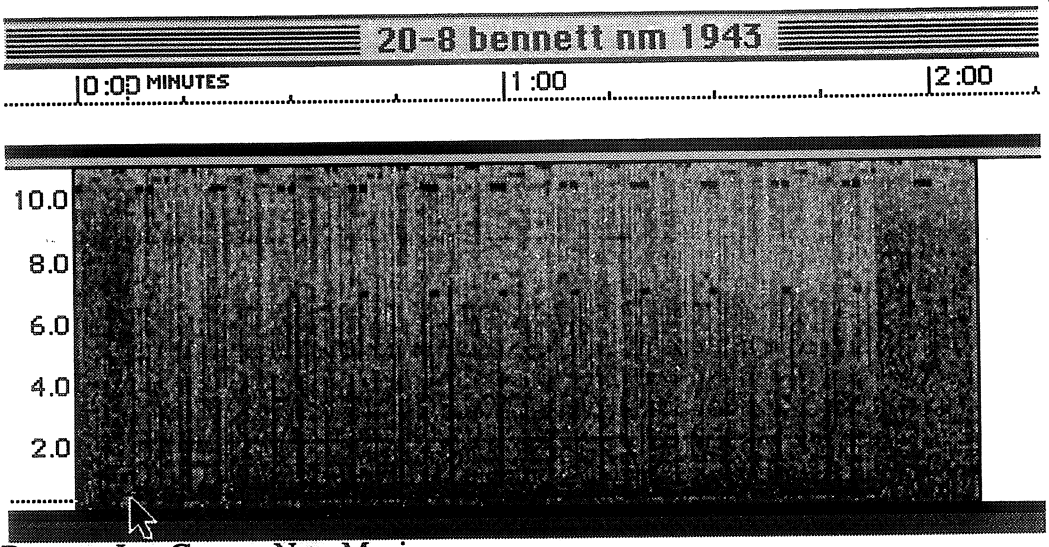


Whistler that occurred just after the start of the tape (before the operation).

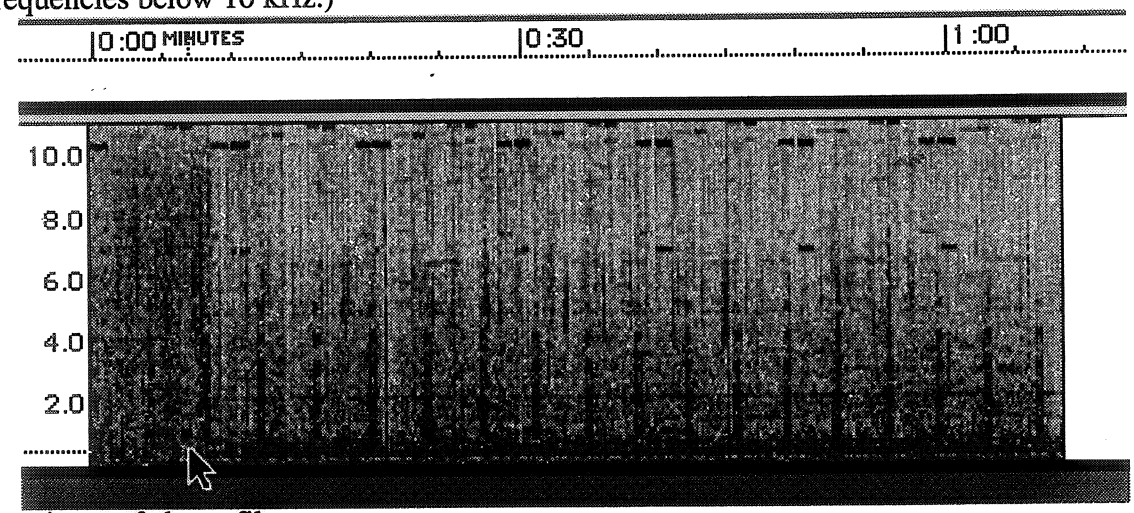


Another whistler a few seconds after the first.

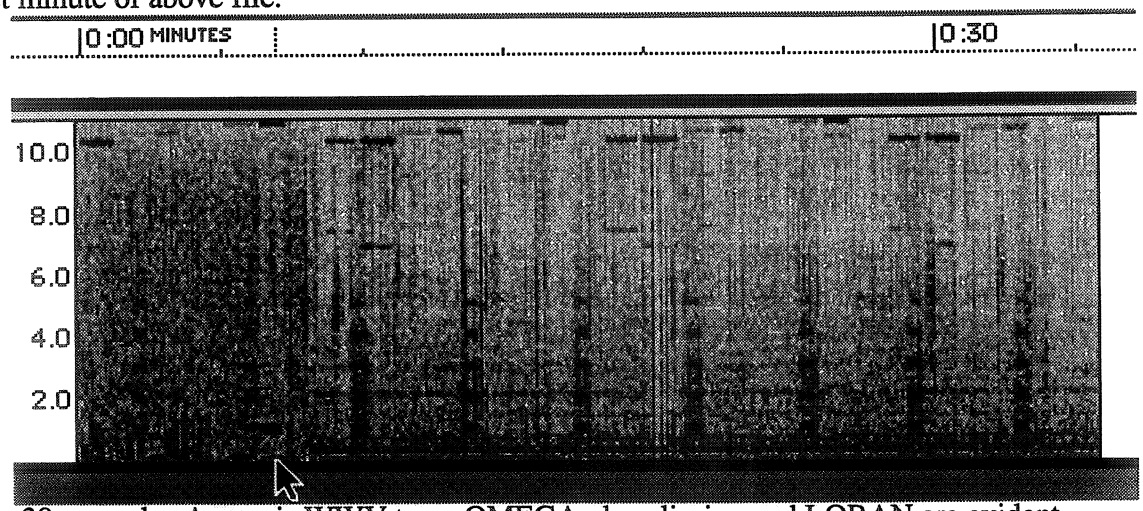
20-8



Robert Bennett, Las Cruces, New Mexico
Arrow points to 1943 WWV tone; sferics, LORAN and OMEGA (note aliasing of OMEGA dashes at frequencies below 10 kHz.)

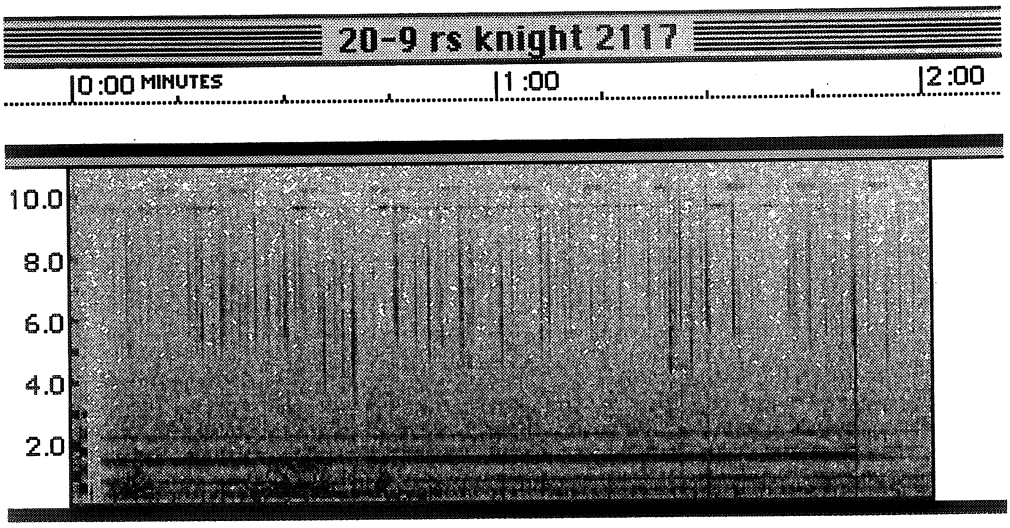


First minute of above file.

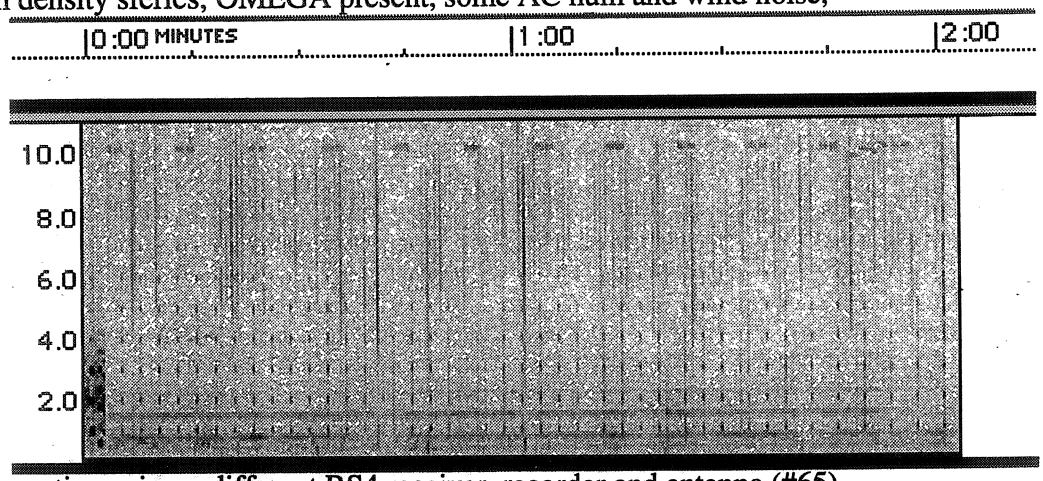


First 30 seconds. Arrow is WWV tone, OMEGA plus aliasing and LORAN are evident.

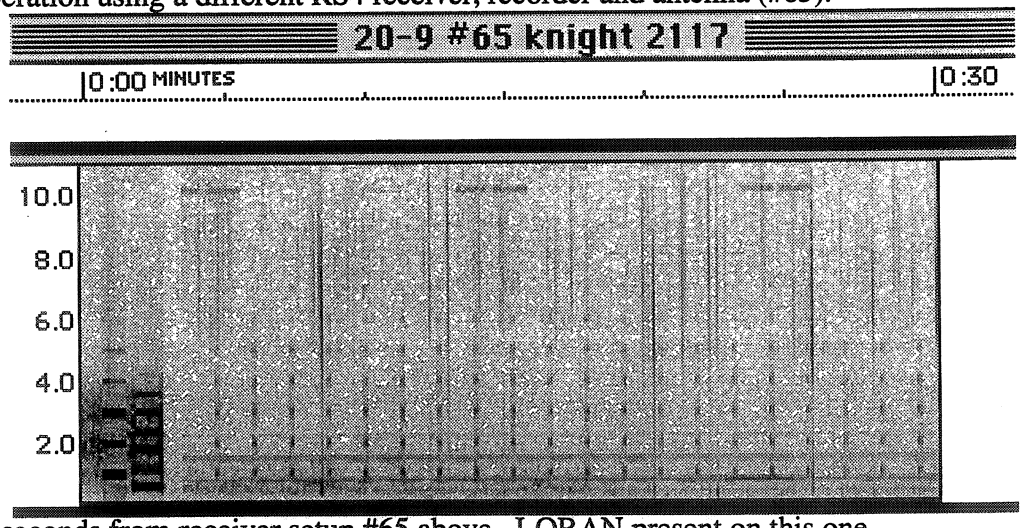
20-9



Dean Knight, Sonoma Valley High School, Sonoma, California
Medium density sferics, OMEGA present, some AC hum and wind noise,

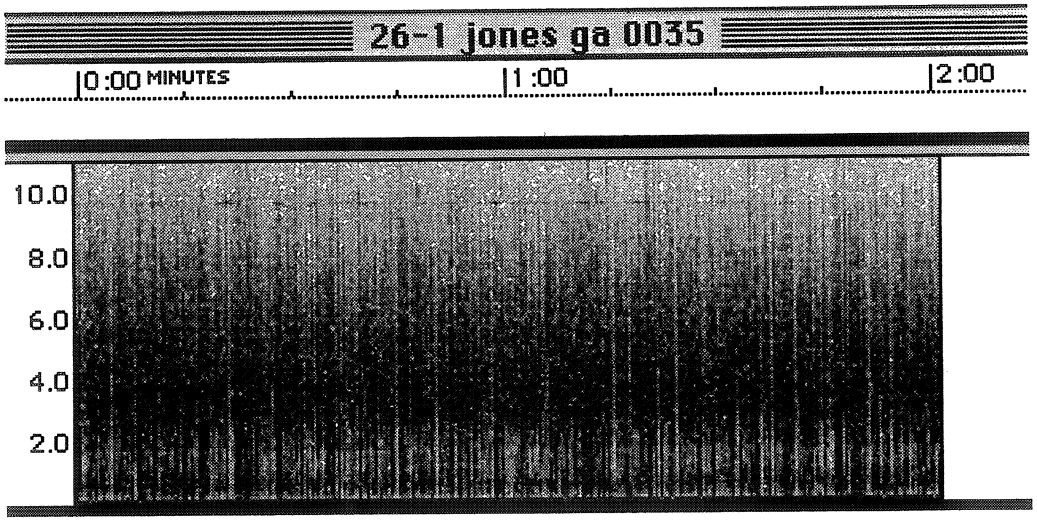


Same operation using a different RS4 receiver, recorder and antenna (#65).

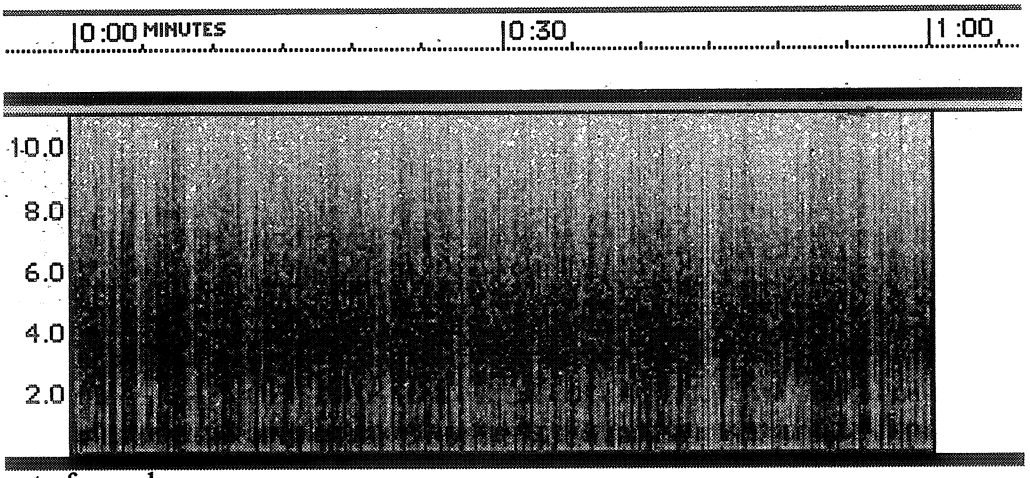


First 30 seconds from receiver setup #65 above. LORAN present on this one.

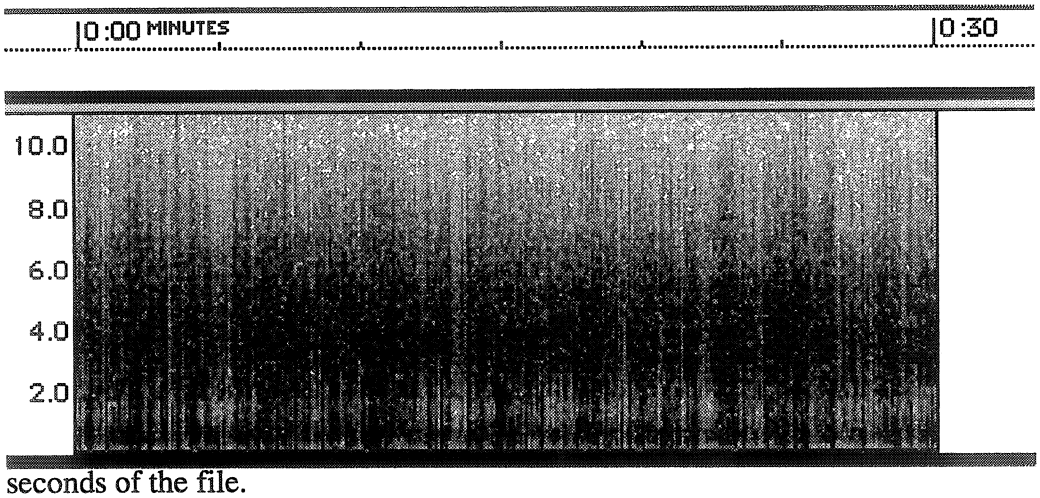
26-1



David Jones, Columbus, Georgia
Very dense, strong sferics due to nearby thunderstorm activity.

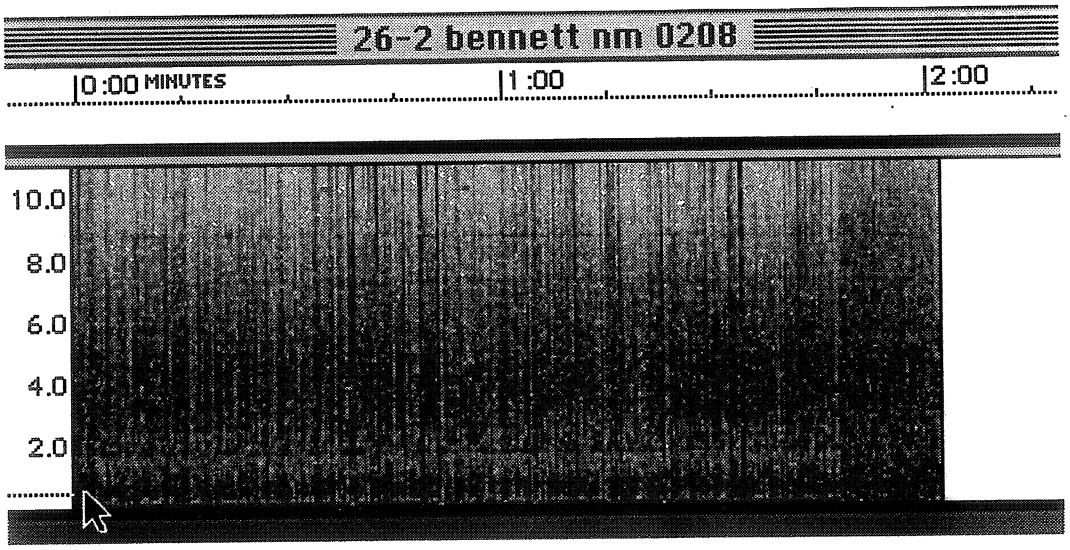


.First minute from above.

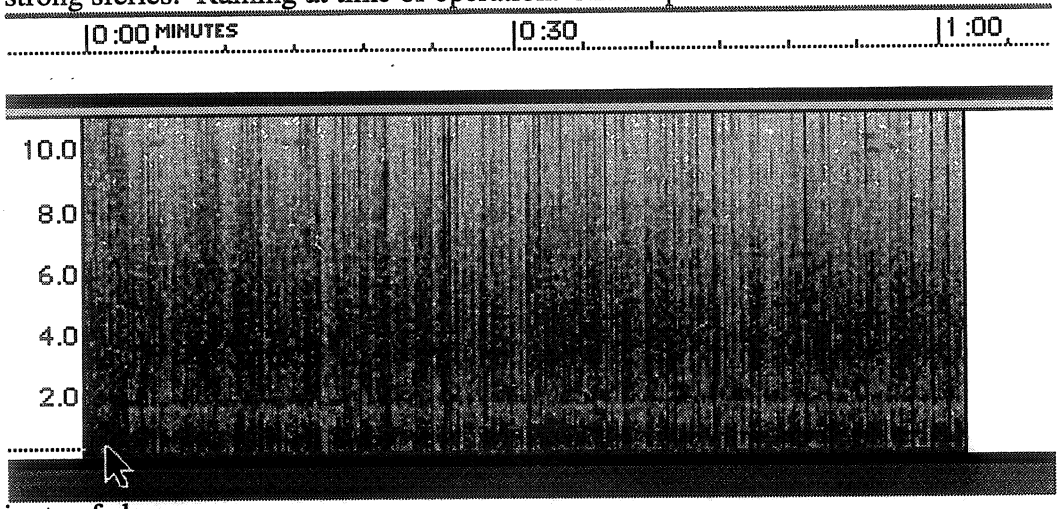


First 30 seconds of the file.

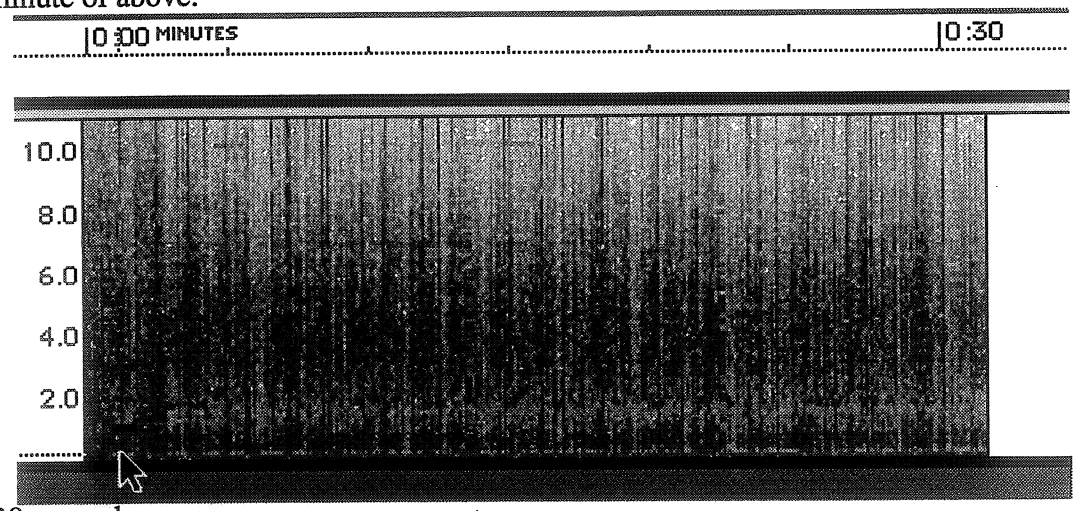
26-2



Robert Bennett, Las Cruces, New Mexico
Dense, strong sferics. Raining at time of operation. Arrow points to 0208 WWV tone.

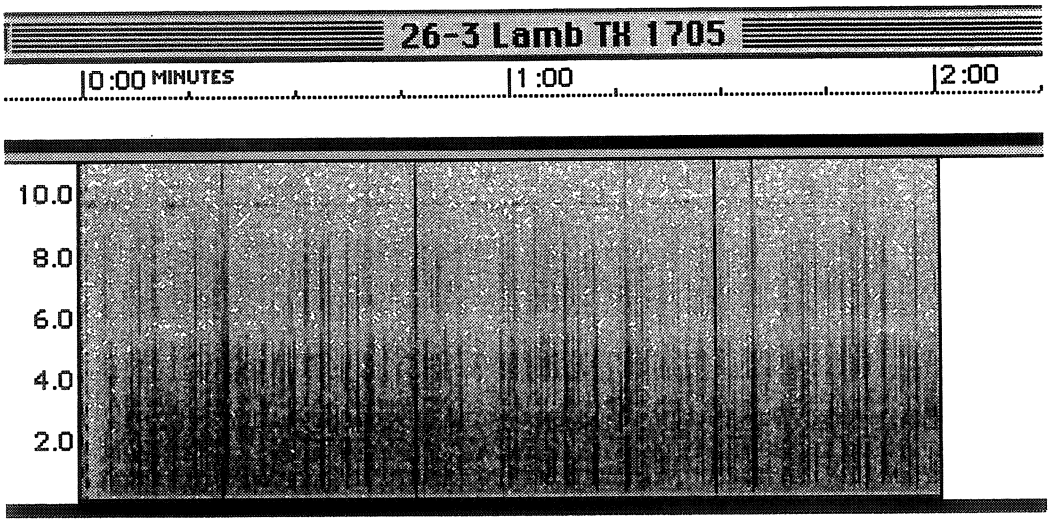


First minute of above.

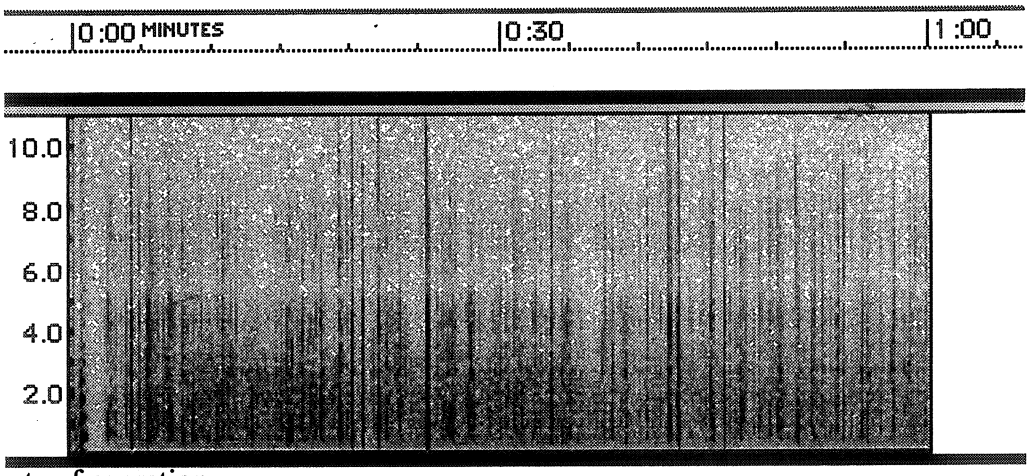


First 30 seconds.

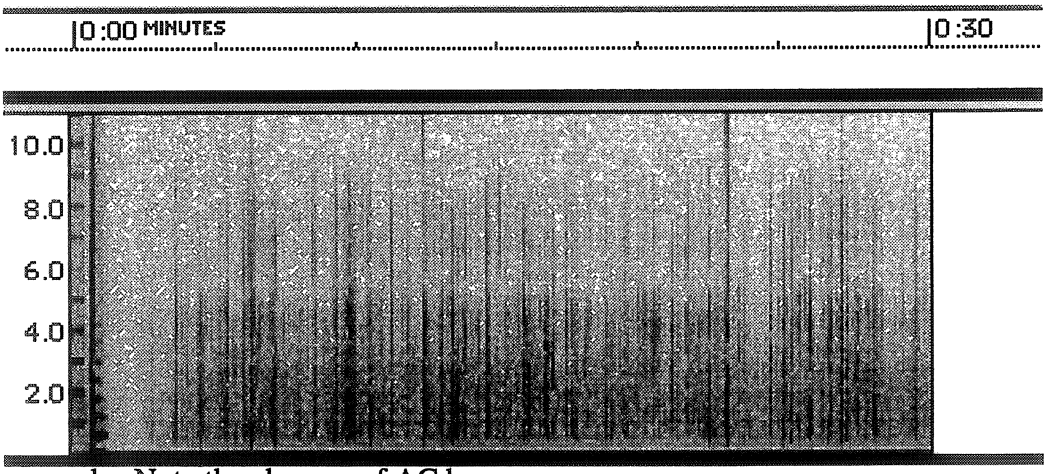
26-3



Jack Lamb, Belton, Texas
Dense sferics; file starts with the 1705 WWV tone.

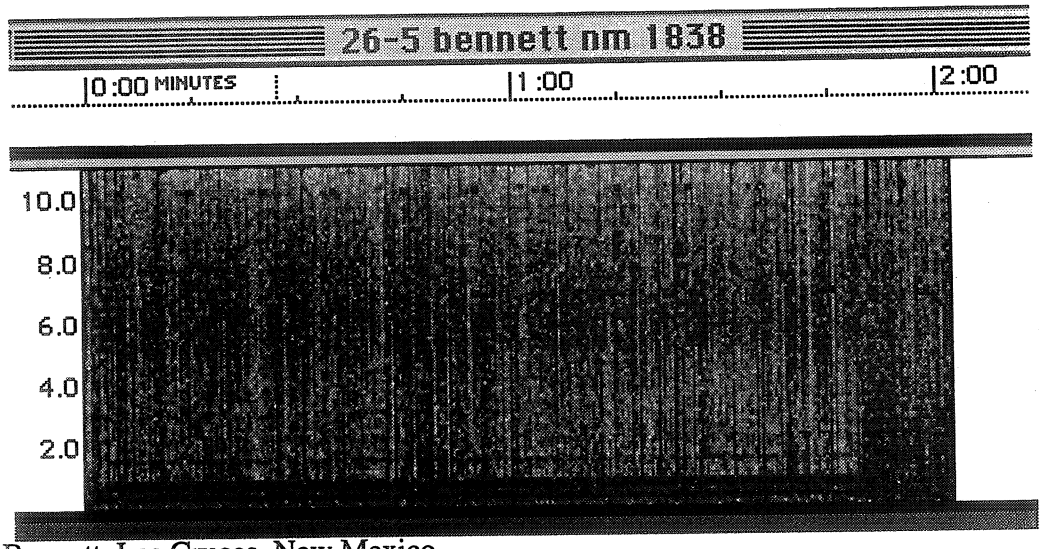


First minute of operation.

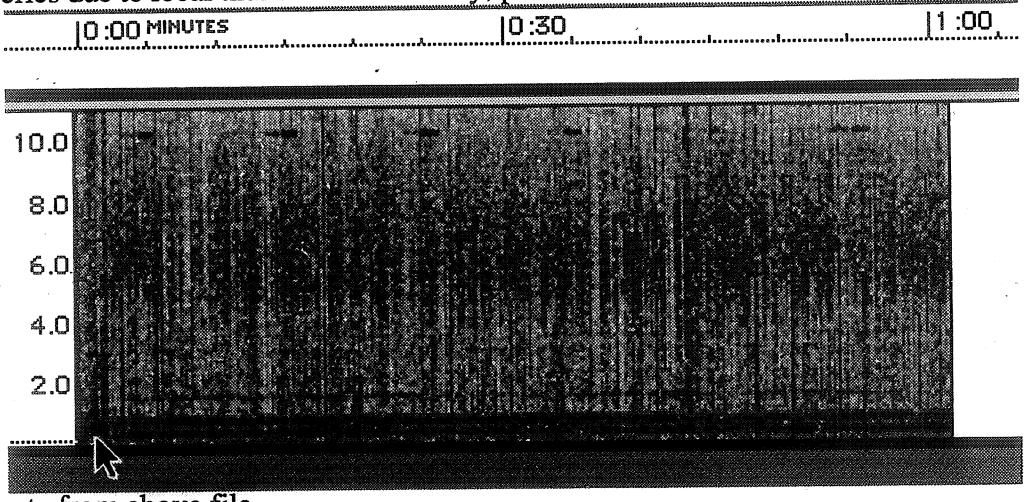


First 30 seconds. Note the absence of AC hum.

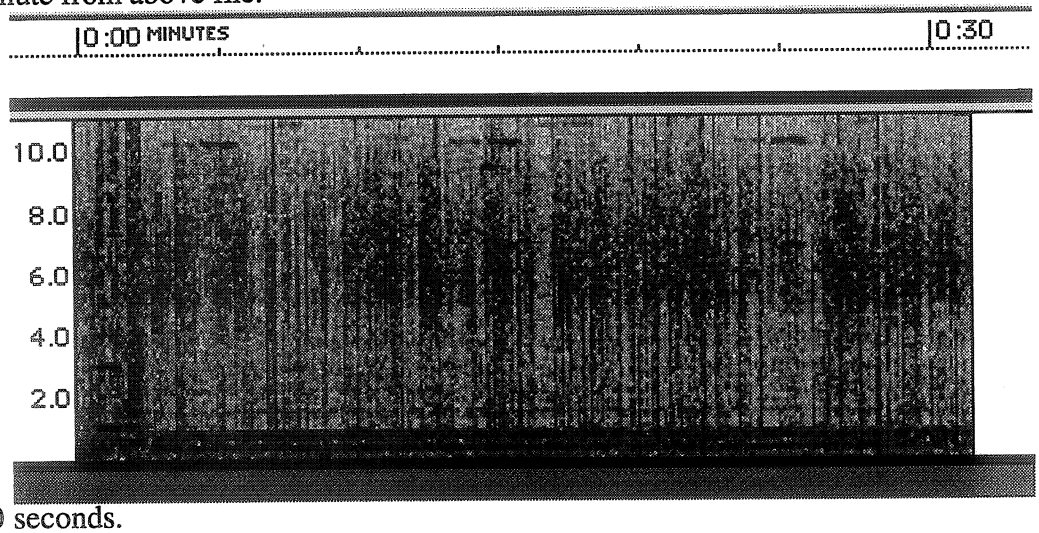
26-5



Robert Bennett, Las Cruces, New Mexico
Dense sferics due to local thunderstorm activity; prominent hum.

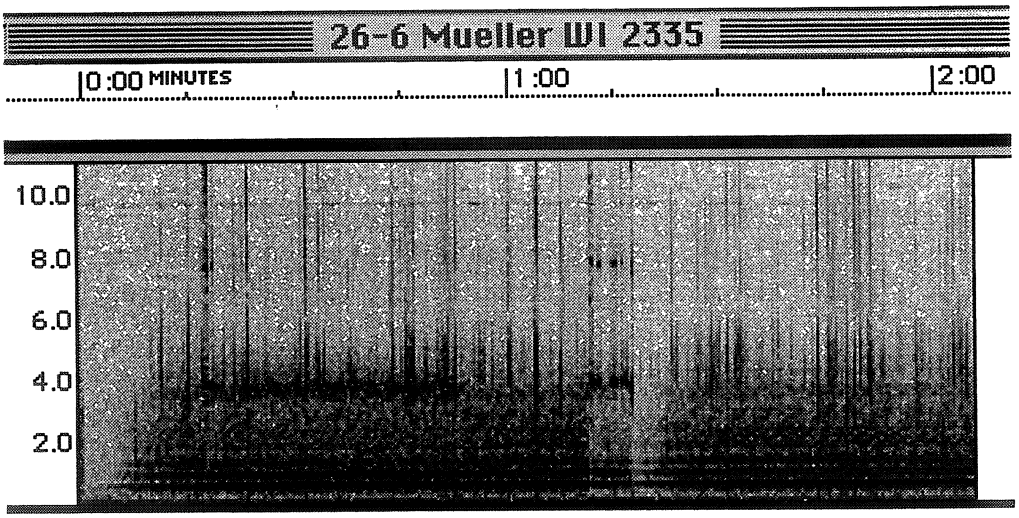


First minute from above file.

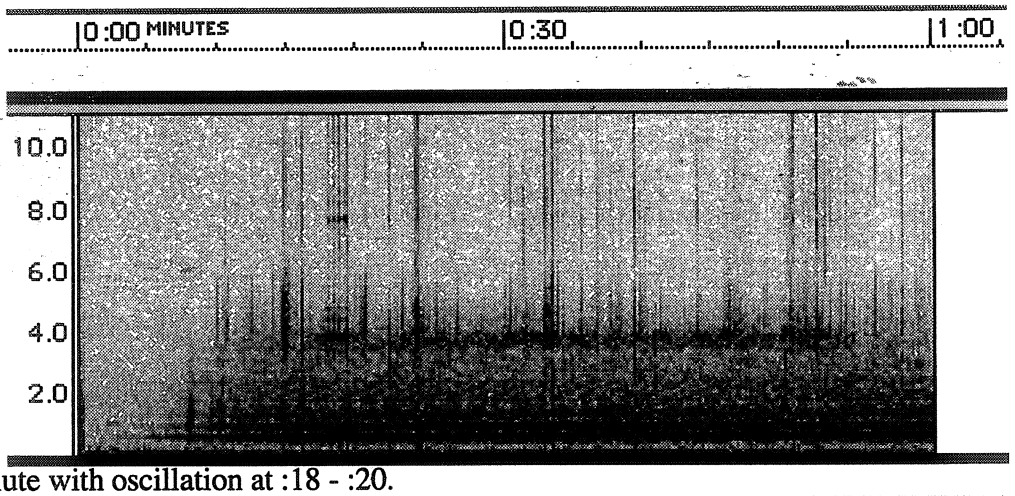


First 30 seconds.

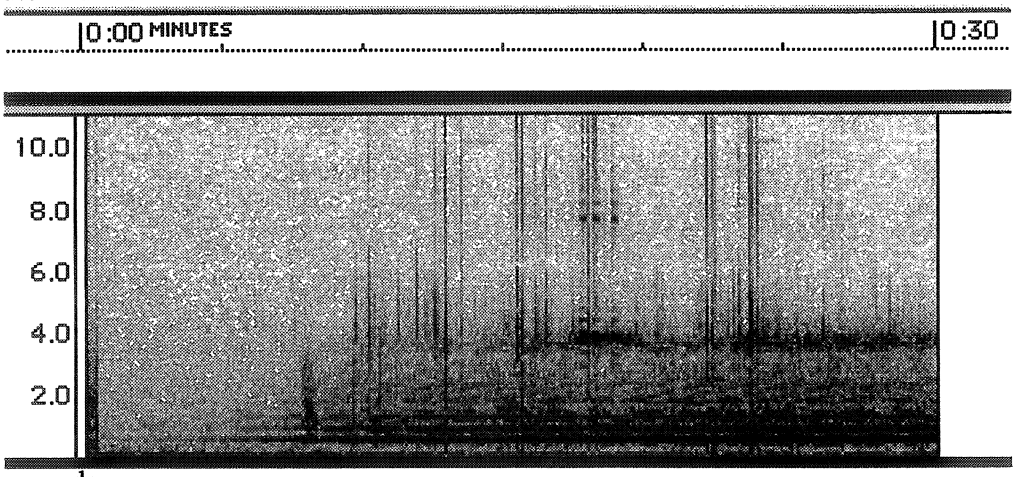
26-6



Mark Mueller, Brown Deer High School, Brown Deer, Wisconsin
Medium density, strong sferics. Prominent hum bands below 2 kHz. Intermittent oscillation shows up at about 15 seconds and again at 1:10.

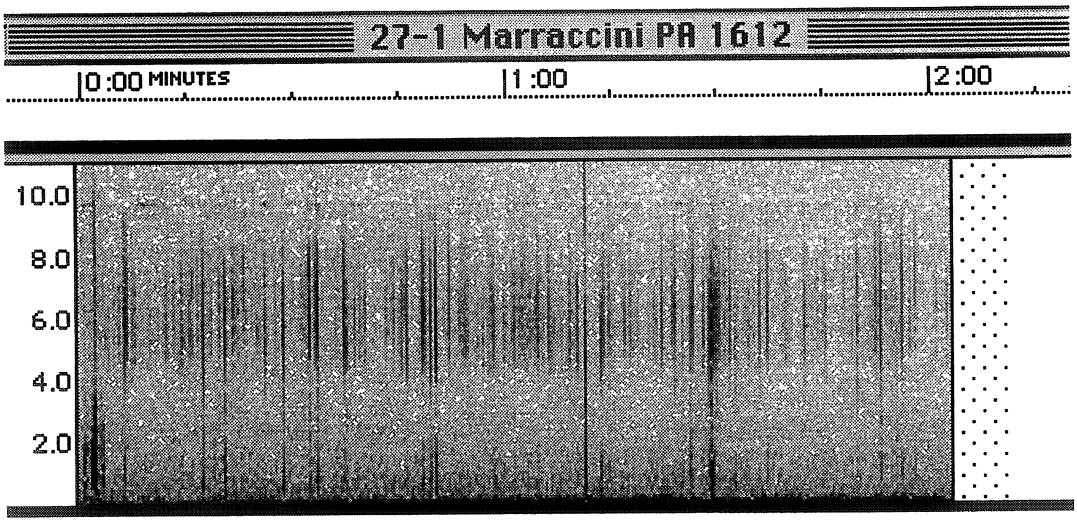


First minute with oscillation at :18 - :20.

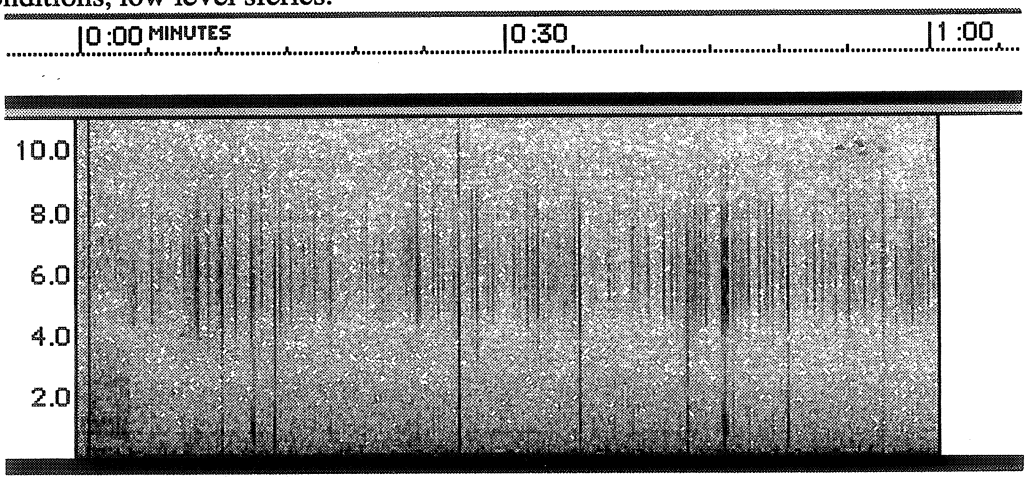


First 30 seconds.

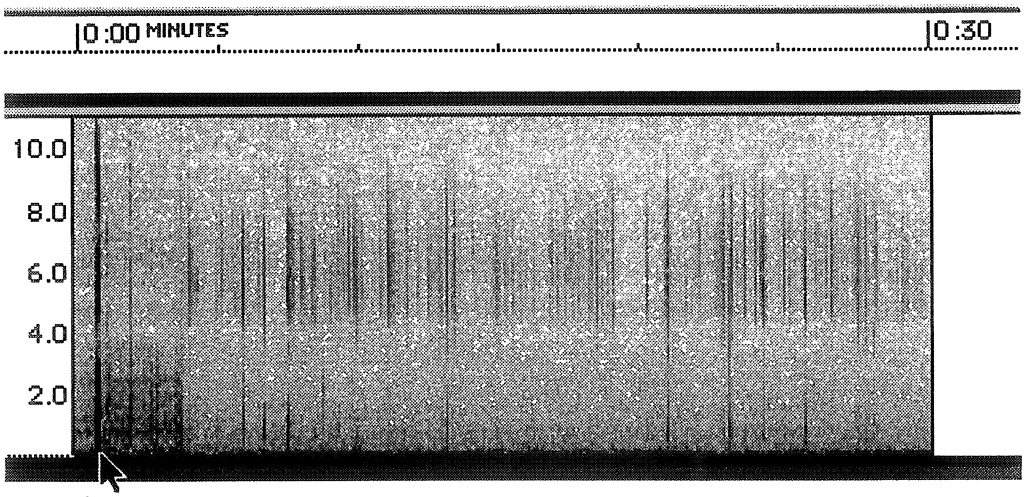
27-1



Leonard Marraccini, Finleyville, Pennsylvania
Quiet conditions, low level sferics.

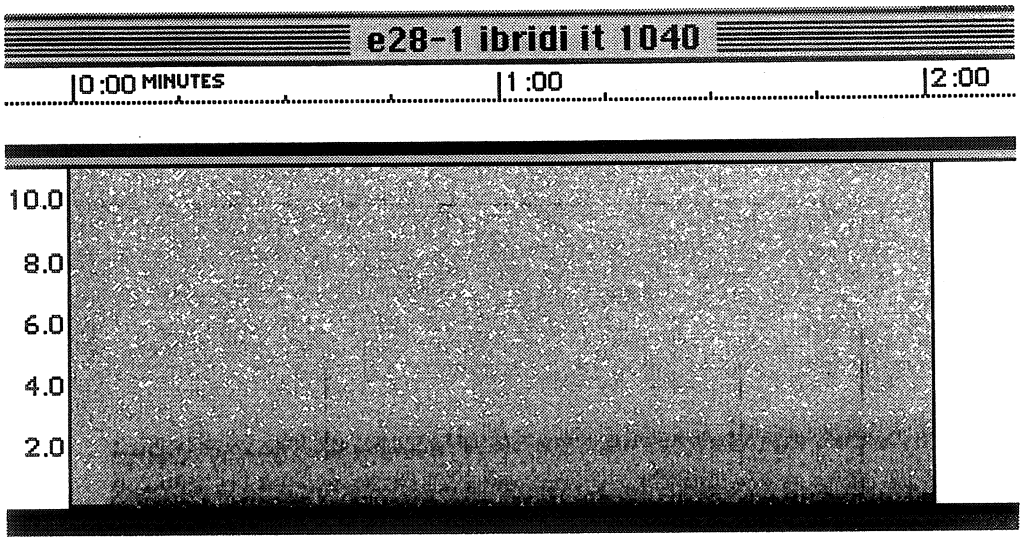


first minute.

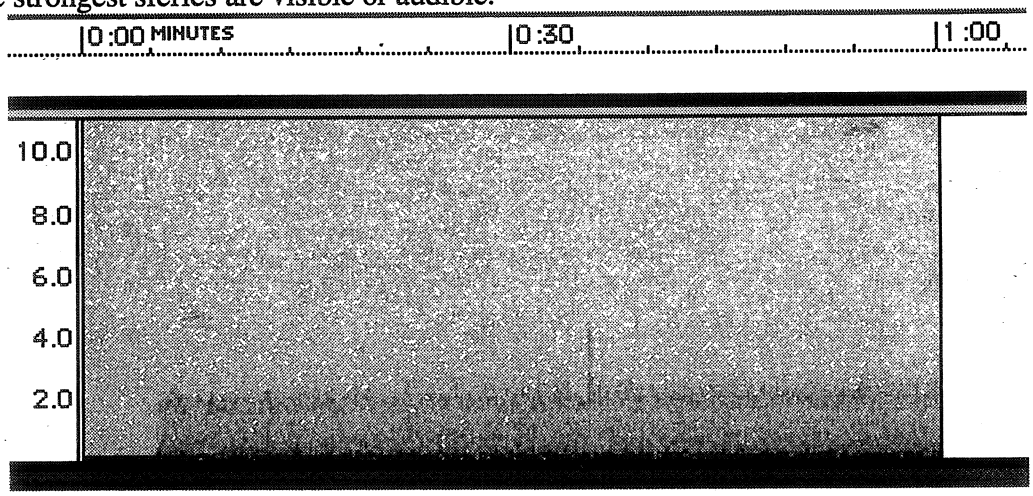


First 30 seconds.

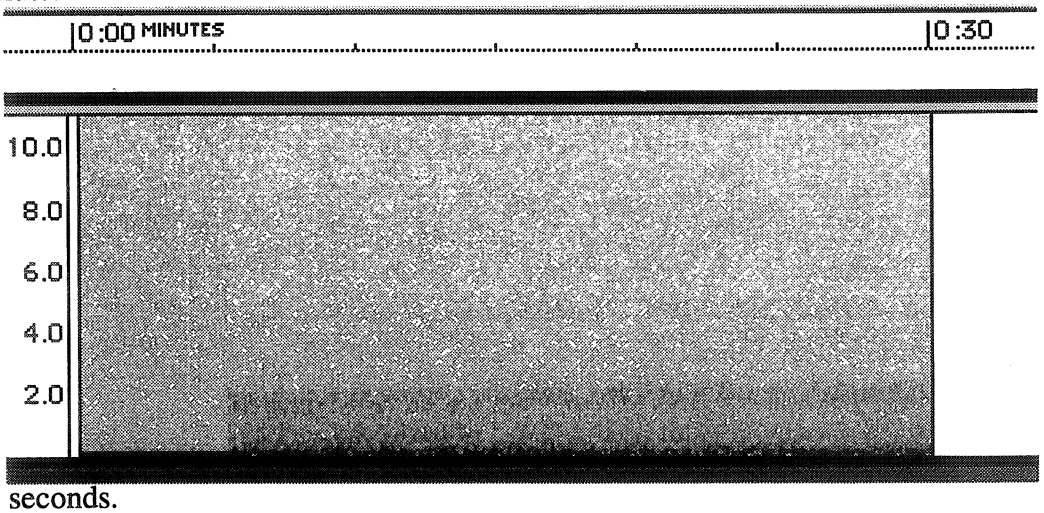
E28-1



Marco Ibridi, Aosta, Italy
Only the strongest sferics are visible or audible.

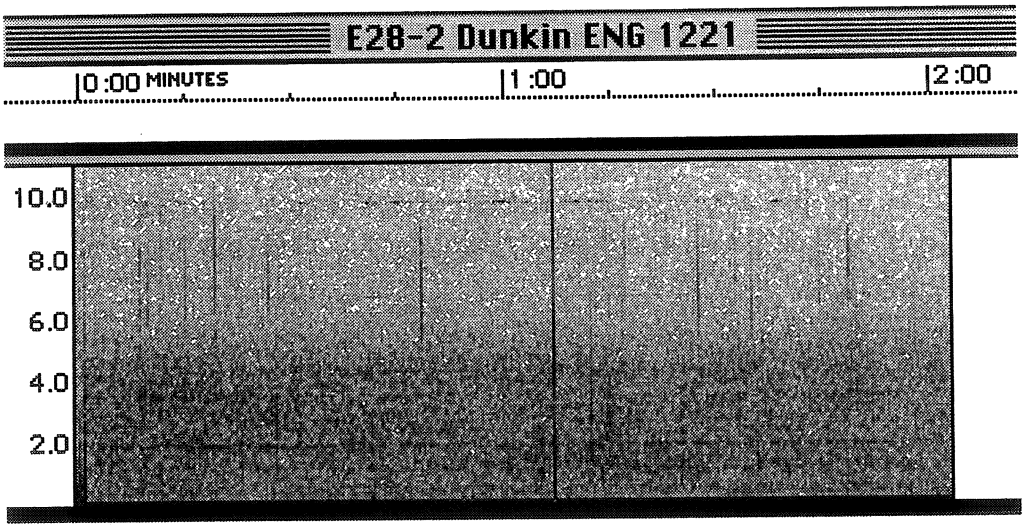


First minute.

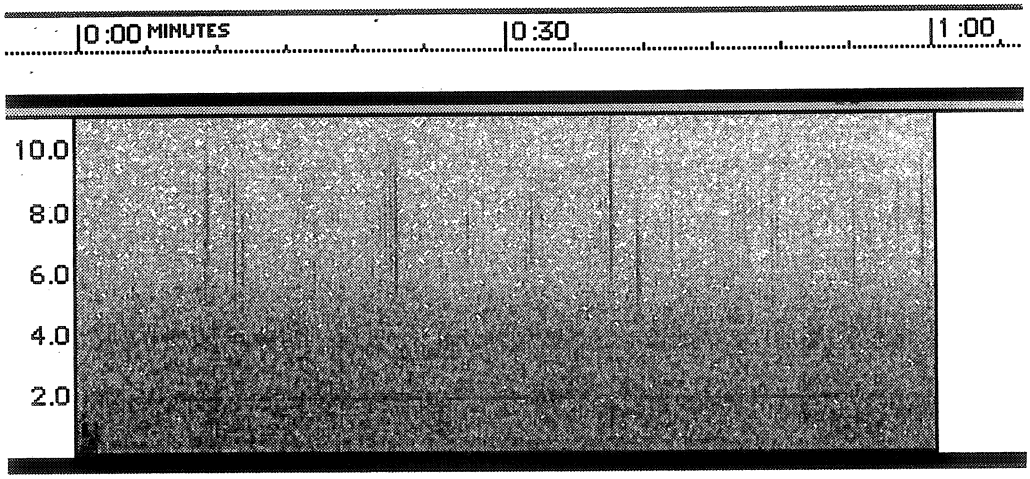


First 30 seconds.

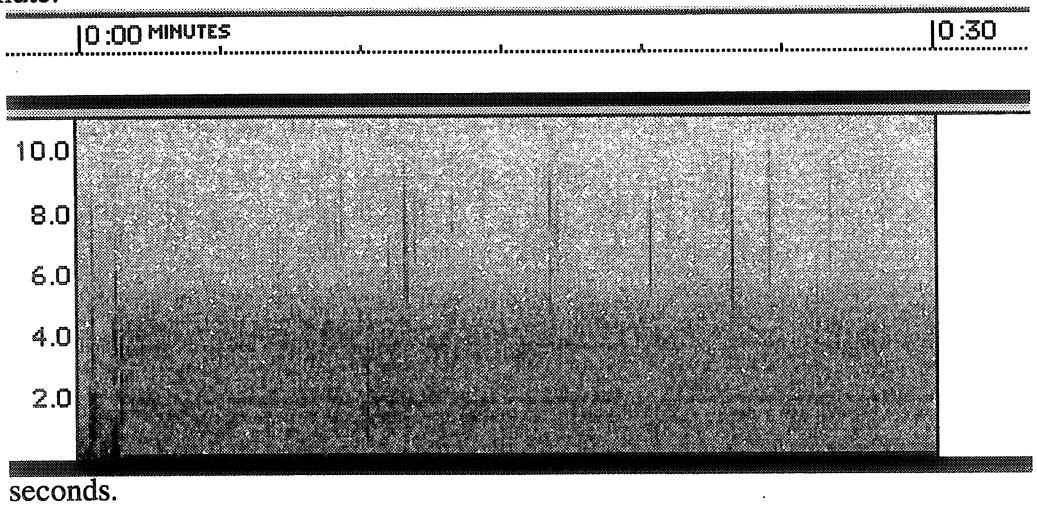
E28-2



Sarah Dunkin, University College London, London, England
Quiet conditions with only a few sferics present.

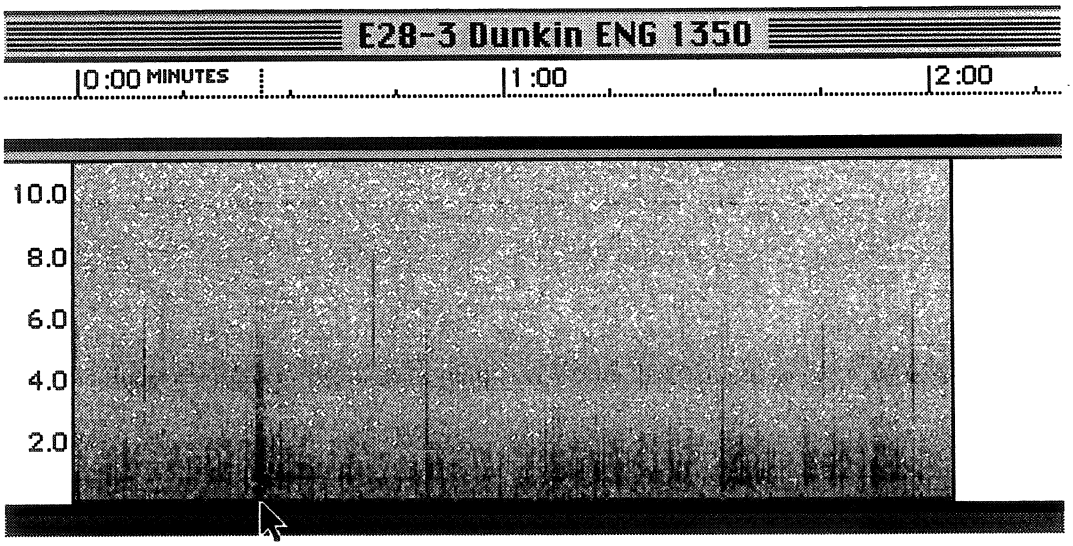


First minute.

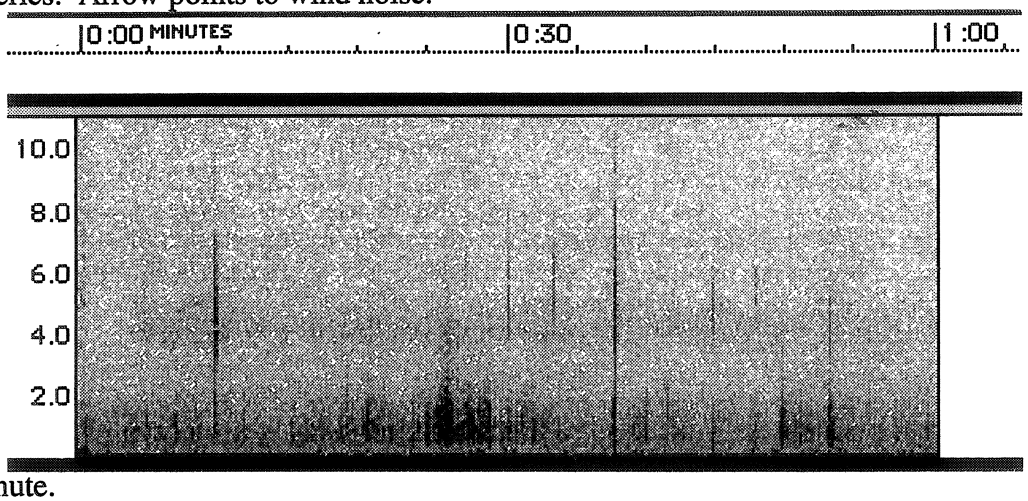


First 30 seconds.

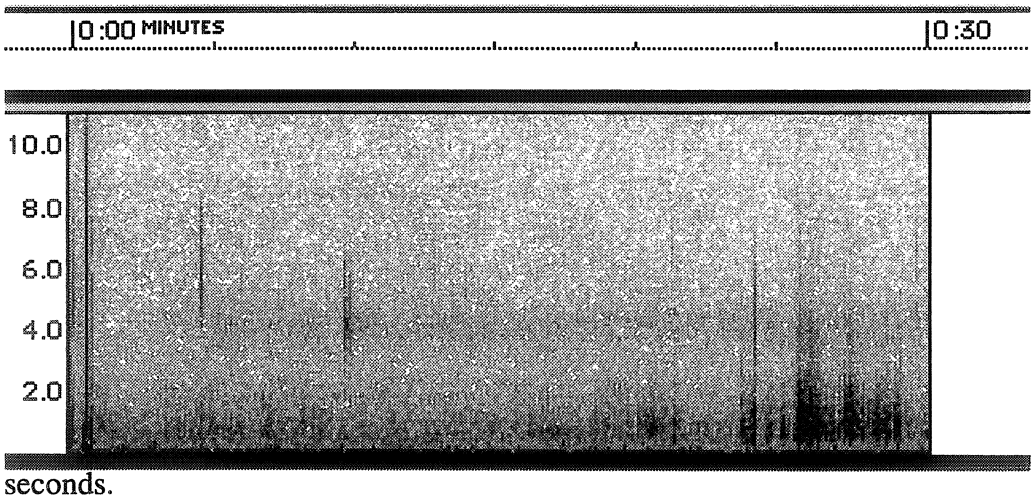
E28-3



Sarah Dunkin, University College London, London, England
Quiet sferics. Arrow points to wind noise.



First minute.



First 30 seconds.

Notes From the Field

Communications from INTMINS Participants

Edited by Bill Pine
Chaffey High School
Ontario, CA

Data submissions are often accompanied by notes and messages from INTMINS participants describing various aspects of their experiences as observers. As an ongoing feature, some of these communications will be summarized in *The INSPIRE Journal.* The following summaries are in the approximate order in which the data was received by INSPIRE.

Team 18 David M. Jones Columbus, Georgia

After a weekend spent inside searching operation 26-1, I am sending you the tape. The MIR flew nearby at about two thirds the minutes between sunset and the end of civil twilight. Although Scott stood outside the car looking for it, too much light remained. Scott volunteered to help out for one practice session and the Friday twilight overflight. The director of the nearby Space Science Center suggested him. Scott has been a disk jockey and now works at a TV station. He knows about split second timing and good sound. He also mans the consoles for Saturday simulated moon landings at the Space Science Center. Thanks to him, I didn't waste precious recording seconds switching between the MIR and time hacks.

Friday evening, when the time came for us to get together, I spotted him looking for a parking space in my neighborhood. An outdoor riverfest had pre-empted our planned get-together at the Space Science Center a block away. We drove to the Alabama side of Fort Benning. The Chattahoochee River almost surrounds a former paratrooper landing field where we set up. You can see the easterly penetration of this bend into Georgia on any state outline map. I put the antenna through the sunroof while Scott assembled the RS-4 and the Radio Shack cassette recorder. I didn't earth ground the receiver since I didn't want too much gain. Thunderstorms in East Texas might overload the receiver. The car provided a counterpoise. I sat inside and put in plain view a big clockface-drawing of events.

We rolled the tape and took a hack at 0023Z. T-time was 0035. The East Texas thunderstorms filled up all of the clear space with strong sferics and occasional tweaks. I could barely hear Omega which surprisingly didn't record at all. I suspect the tape quality. It was the first time I used it. Loran-C was absent. No whistlers occurred. We missed the 0048Z time hack but recorded the double tick at 0048:30 after the missing tick . We hacked at 0049. I didn't hear the one-kilohertz tone from MIR. Receiver gain was max and Scott rode the gain on the cassette when he wasn't outside looking at the sky. Filter was off and the antenna selector, whip. We made no connection to the WWV receiver and instead Scott held the microphone close to the radio speaker.

Back at my apartment, we played the tape back through Mike Cook's weak-signal program FFTDSP42u. We also made a quick .wav and displayed it on R.S. Horne's Spectrogram 2.3. I refined the recordings over the weekend. You might look close at 0034:57.7 and 0037:36.6. I suspect those are the seventeenth harmonic of powerline freq which seems to be everywhere I drive. Why aren't lesser harmonics as evident?

There is a lot that I don't understand about VLF wave propagation, and the behavior of harmonics tops the list! Anybody have any thoughts on this? - *ed.*

Team 3 Don Shockey Oklahoma City, Oklahoma

I like the new VLF2! It seems far more sensitive than the older model but my first venture was only partially successful. The second seemed to go better: Operation 20-2: a faulty switch marred everything up to "T" time, when things worked for about 3 to 4 minutes then went south again. Operation 20-8: Disconnecting the switch let the operation go much smoother. Very few operational problems and hopefully the data looks as good. All in all, the new receiver will be a plus and I look forward to the next round.

Don is one of the most faithful INSPIRE observers.

Team 1 Jack Lamb Belton, Texas

A funny thing happened on my way to my listening spot on the 20th. I found the road to it closed and locked because It was under water. As you may have heard, we have had lots of rain this year in central Texas. We have not had the flooding like they have in North Dakota but some things are inaccessible near lakes. I hurried to find higher ground that was quiet. I wandered through farm roads looking for the absence of electric poles. Finally I thought I had a good place. I was running out of time to search too. The first recording seems pretty good except for a low pulsing sound in the background I have not heard before. Perhaps you can identify it. The second recording was made on the 26th when a rain storm was all over Belton and Kileen. Matt and I looked on the TV weather map and saw that the storm had passed Lampassas, so we drove there and found a farmer's driveway that was surprisingly quiet. We recorded the biggest bunch of noise I have ever heard. Unfortunately, I did not hear any whistlers on either tape. I also did not hear anything I thought was from MIR. However, I hope whatever I did record will be of some help in forming the total picture.

Thanks for the answer to my question in the Journal. Now I can explain a bit better what we are trying to do. I hope to interest some students at The University of Mary Hardin Baylor here in Belton where I am now teaching part-time. Maybe they will become excited about delving into an area where little is known.

I wonder if you could speculate in the next newsletter about what we might discover about the magnetosphere with our listening equipment (did I miss reading about that in a previous Journal?). I also hope you can report in that newsletter that someone actually recorded a signal from MIR. Finally, could you compare the new VLF2 with the old one, especially how much better the data was this time. I am debating whether or not to buy one.

I hope Lake Belton goes down to normal over the summer so I can use my old recording spot in November.

Investigation of the magnetosphere is a daunting proposition because it is so vast in size. Since we can't go everywhere in the magnetosphere, we need some way to investigate it from here. This is called remote sensing. Rather than measure the magnetic field strength directly by going to each location, we instead examine what has been to various places in the magnetosphere - namely natural radio signals. The propagation of these signals is influenced by such things as the magnetic field strength, the shape of the magnetic field and the charge distribution and densities in the magnetosphere. It is attempting to increase the scientific knowledge base about these things that magnetospheric research is all about.

To this point in time, no confirmed recordings of the signal from MIR have been made. The new receiver seems to be more sensitive and should, therefore, increase the chances of successfully detecting the signal from MIR.

Team 13 William Combs Crawfordsville, Indiana

20-2 There were small tweeks and sferics throughout the tape but no signal was received from MIR. The site this time is in the south end of the Camp Atterbury Military Training Area. No power lines were within a mile of the Artillery Firing Point that I occupied. Comet Hale-Bopp was nice and the coyotes provided background music. I ran the tapes through the AD12 (spectrum analysis software for the PC) and it appears to be nice and clean.

26-6 There was much static or sferics. The wind was blowing and I think there was some noise from the sun. A neighbor was planting about 1/4 mile away. Line hum seemed satisfactory. I could not detect a signal from ISTOCHNIK. A tremendous difference from 20-2 as far as background.

Team 22 Rick Campbell Ann Arbor, Michigan

My recording adventure began with months of preparation. I started by building a receiver matching the specifications of the RS-4. I have built ELF receivers in the past but always using loop antennas, never using high impedance vertical whips. This being completed, I searched for a quiet spot and started to gather the recording gear and various patch cords needed for my data gathering setup. Finding a quiet site proved to be the most difficult. I am an amateur astronomer and I always complained about light pollution, but now I can add AC power grid pollution to that complaint! The most easily accessible site proved to be near a golf course here in Ann Arbor, Michigan. I called the local director and he graciously granted me permission to use a large field owned by the University of Michigan near the course. I took some experimental recordings at other various spots around the area at various times of day to become familiar with the sounds of natural radio emissions.

When the orbit schedule arrived I chose 3 passes that were within my area: 19-1, 19-2 and 20-1. 19-1 was a little off, but only about an hour and a half before 19-2, and it seemed that I could use it as sort of a shakedown run, so I chose to record it. Well, as usual, it was not ideal. Minutes before the recording was to start, the 5 MHz WWV signal that had been booming in suddenly faded to almost nothing. I switched to 10 MHz and was relieved that it was at least audible but still weak. I admit I must have looked odd. Here I was sitting in a lawn chair by a small table in the middle of an open field! The temperatures dropped in the low 30's (F) but I was comfortable. An almost full moon, Mars in the southeast and Hale-Bopp in the east made the passing time serene.

On the way home I reviewed the recordings and discovered that a low level WWV signal propagated to the recording. My setup included a switch I could throw that would pass the time signals at the proper intervals through a mixer, but how did this signal pass through? My first thought was the external speaker (about 3 feet away from the ELF receiver) so I planned to connect a pair of headphones the next night. I did some tests and ruled out any patch cords or the mixer. On Pass 20-1 I would try the headphones.

On the 20th, WWV was stronger and 10 MHz was of sufficient strength. The almost-full moon provided enough light for me to see well without a flashlight! Skies were again clear and the stars and Hale-Bopp were bright. Driving home I again noticed the dreaded WWV signal bleeding through the recordings. They were low level but noticeable. What with the background AC hum and the WWV signals I was doubting that the I kHz signal would be discernible at all. All this work and my recordings were flawed by this pesky signal. I vowed to resolve the problem and redouble my efforts with the next round of recordings perhaps later in the year.

Team 5 Jean-Claude Touzin St. Vital, Quebec, Canada

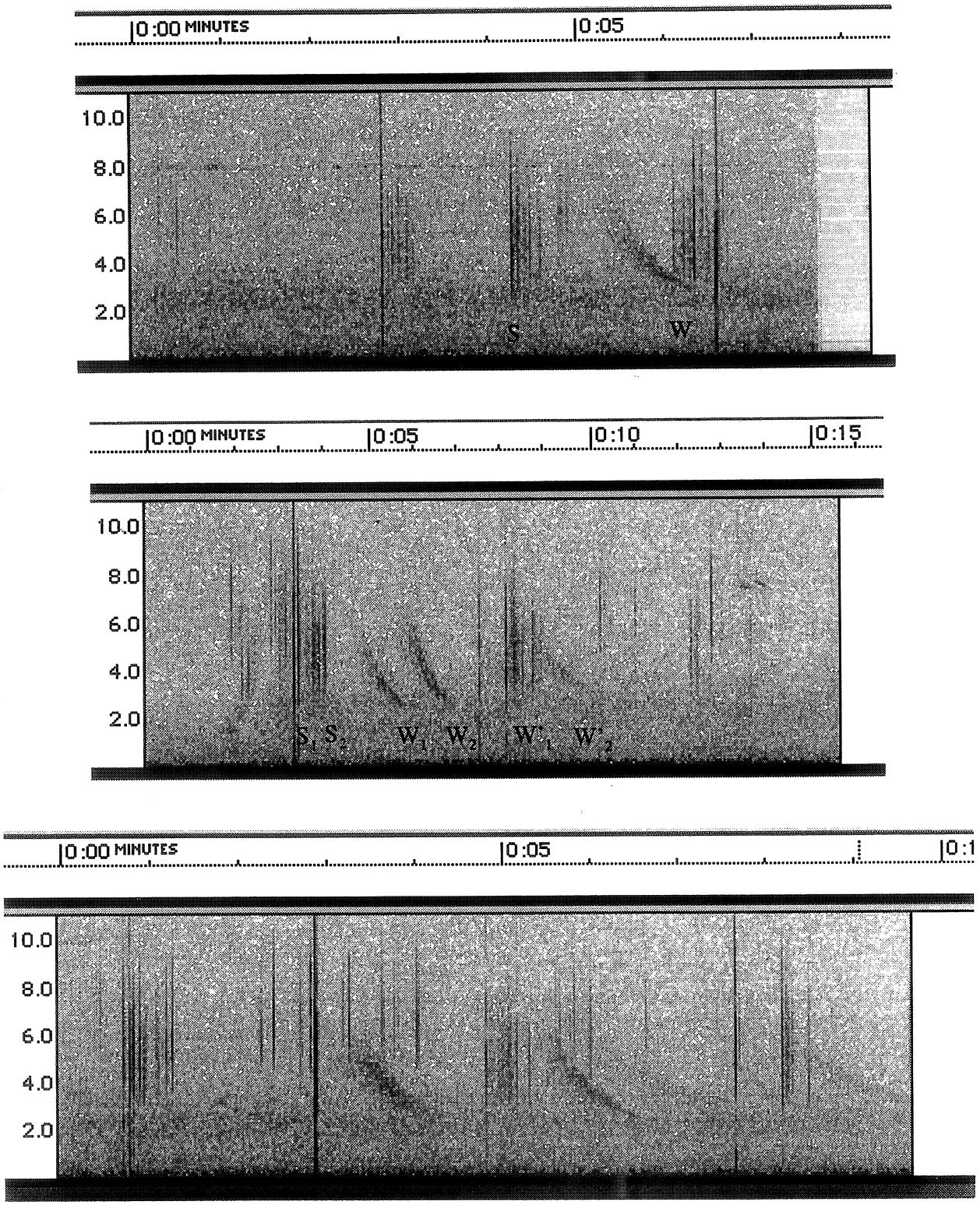
I had trouble going to my site for 26-5. Now my bridge is above water during springtime flood, but both sides of the river were not. I had to cut two trees to make walkways on both sides of the river. Call it "The Never Ending Journey".

Team 16 Leonard Marraccini Finleyville, Pennsylvania

I have enclosed a 5-minute tape segment from a tape which I made on May 2, 1997. I used the same instrument setup (RS4, Sears Cassette Recorder, 2.54 meter whip) and was located at the same test site as for the previous two tapes. I was very fortunate to record a VERY ACTIVE whistler/sferic period. The tape session began at 8:33 AM local time (1233 UT). I did not include any data sheet with this cassette. I though you might enjoy this copy of the 5-minute segment!

Leonard's tape contained many whistlers. They seem to be of the two-hop variety. That means they originated with lightning relatively near to the observation site and the signal bounced off the ionosphere in the southern magnetic hemisphere and returned to this hemisphere. You can tell this from the spectrograms because each whistler is preceded by a strong local sferic. Some whistlers also show a 4-hop echo of the whistler.

Code: S - sferic; W - whistler (2-hop); W' - 4-hop whistler



Multiple strong sferics and whistlers. The darkest whistlers are 2-hop, the fainter are 4-hop echoes of the 2-hop whistlers.

Team 7 Dean Knight Sonoma, California
Sonoma Valley High School

You will note the 20-9 tapes have a much stronger WWV signal at all recorders (compared to 20-3 where I had to yell out "mark" since the short-wave radio kept drifting in and out). I fastened telephone pick-up coils to the outside of the short-wave receiver near the speaker, amplified these signals using 2 small Radio Shack amplifiers and sent that signal to small loudspeakers at each of the other two stations. The students at the other stations could then set their microphones on the speaker to get WWV. Seems to help.

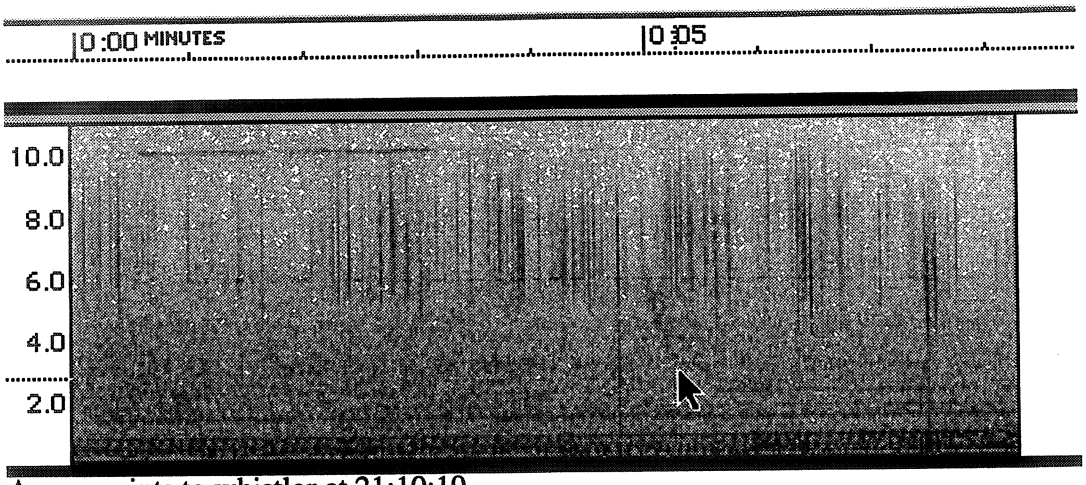
By the way, I understand that we are attempting to pick up a radio signal produced by the ion beam acting as a "virtual antenna". Since charges are being accelerated one would expect noise at that frequency just from the antenna. But is there anything else in terms of magnetosphere interaction or whatever that you (or others) are also looking for (once the signal is detected). I would also be interested in finding out more about this particular investigation. Actually, I am finding the normal atmospheric chatter (and other sounds) produced to be fascinating in themselves, but I also want to understand the full scope of the project.

The "virtual antenna" refers to the fact that the electron beam is projected out into space rather than being carried by a physical antenna. The accelerated charges should radiate electromagnetic waves at the modulation frequency (and perhaps harmonics of that frequency). The first step is to detect the signal on the ground. This has never been done before (and we have not done it - yet). Once the signal is detected, the next step is to analyze where the signal goes. The normal, inverse square radiation pattern should be modified by the presence of the magnetic field of the earth. This is where the increased understanding of the magnetosphere can be realized. We are still a ways short of that goal, but we are making progress!

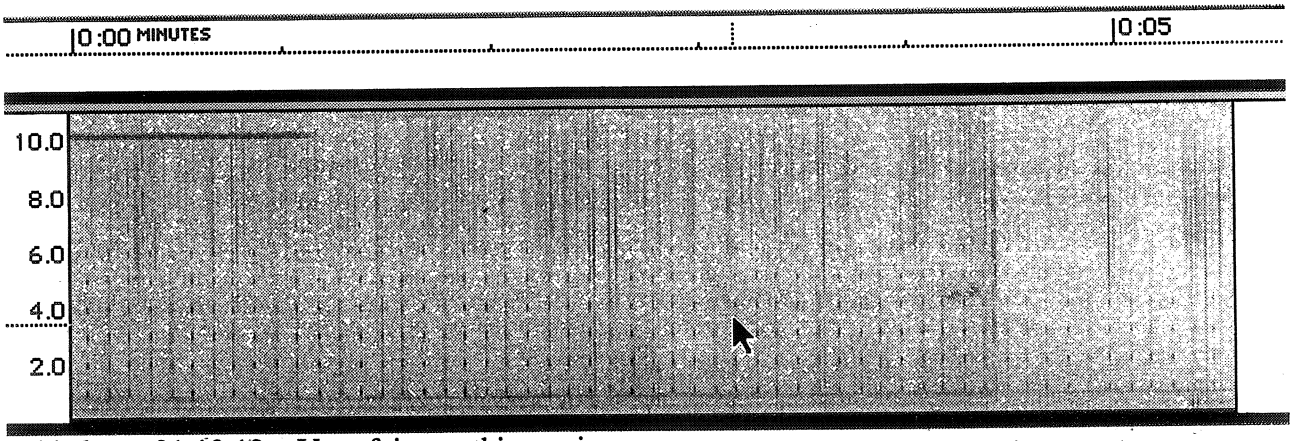
Sonoma Valley Physics Student Observers:

20-3 and 20-9	20-3 only	20-9 only
Whitney Baker	Emilie Connors	Jim Barrat
Betsy Bradbury	Kate Denson	Juan Cruz
Bryan Carlson	Brad Duncan	Abe Gardner
Sabrena Carrington	Lauren Flaherty	Beth Gullikson
Tierra McCulligh	Soren Hansen	Regina Gonzalez
Tom McKeever	Signi Hirsimaki	Brian Johnson
Katy McNulty	Jenne Leigh Hotthouse	Katherine Merritt
Scott Morse		
Nathan Prziborowski		
Jenny Scafidi		
Camille Varin		
Jenny Watters		

Some whistlers were recorded during these sessions. Some of the same whistlers were recorded by the Chaffey High School team which was observing about 500 miles to the south.



Arrow points to whistler at 21:10:19

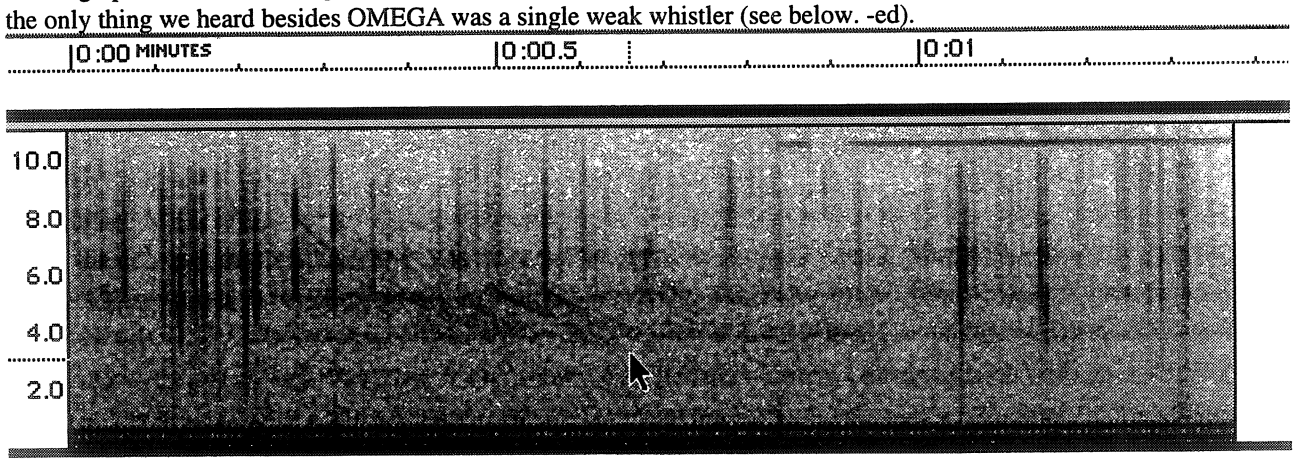


Whistler at 21:10:19. Very faint on this receiver.

Team 23 Jim Ericson Glacier, Washington

In spite of a nasty winter, the local librarian (Paula Dunn) and I managed to get a little ways up a logging road and catch the April 19th Pass 19-5.

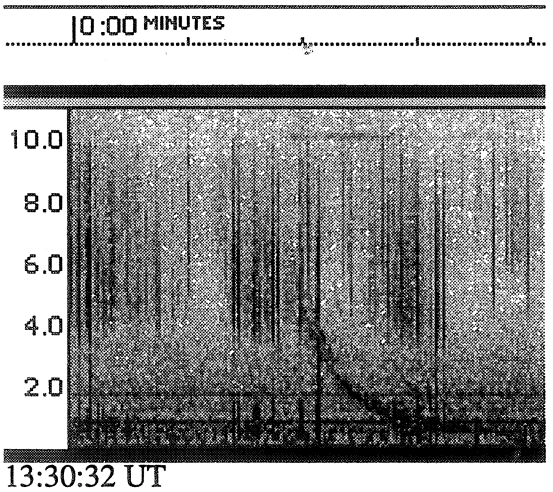
Due to icy conditions farther up, we could only get about 1.5 miles from the local high-voltage feeder line which runs along Mt. Baker Highway. It was raining like crazy, so we abbreviated our antenna party somewhat, winding up with a 50 foot long wire from the receiver to a branch on a nearby dead tree. Hum was pretty heavy and the only thing we heard besides OMEGA was a single weak whistler (see below. -ed).



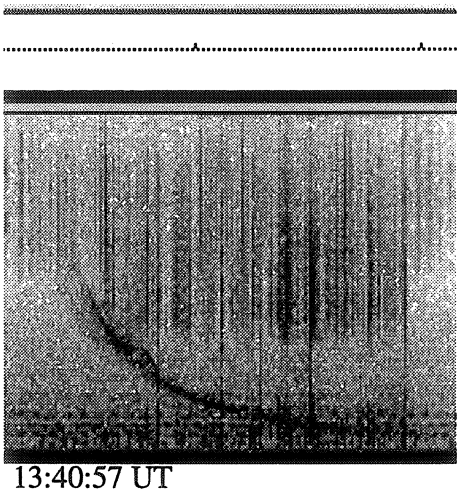
Paula is the local librarian here in our tiny village of 120 people. she has her own WR-3 receiver and spends quite a bit of time in the nearby mountains doing whistler hunting. She is quite enthusiastic about INSPIRE, whistlers and Amateur Radio (her call sign is KC7VKL), and is doing her best to get local high schoolers involved in these projects as well.

Team E2 Silvio Bernocco Vaccera, Italy

Silvio captured some great whistlers during his 20-4 session. Below are some pictures.

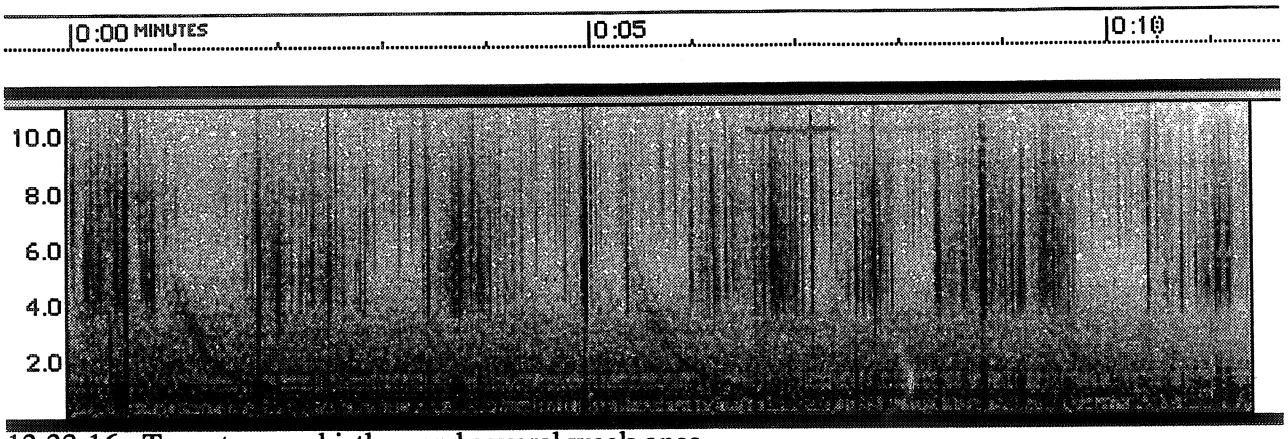


13:30:32 UT



13:40:57 UT

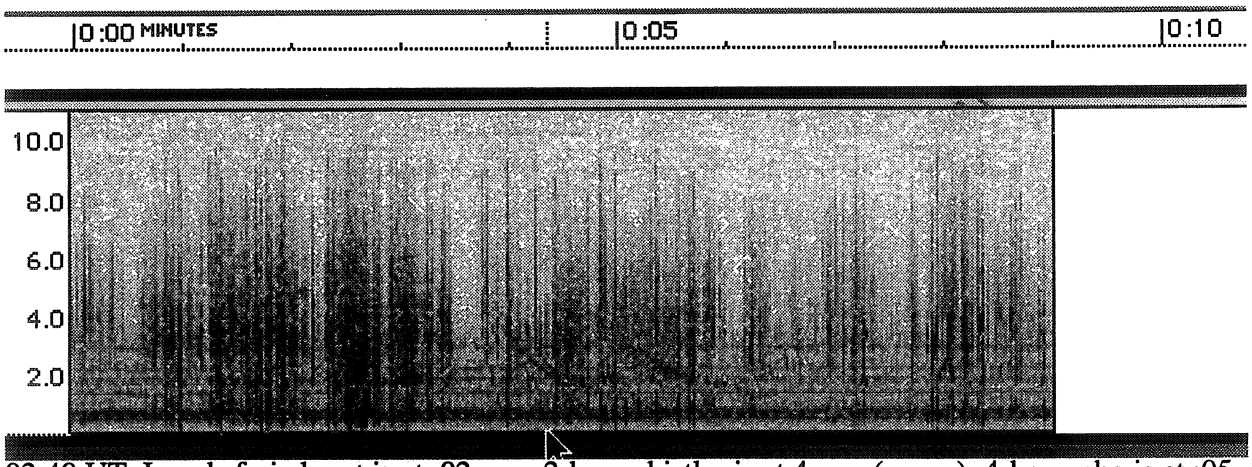
Notice the long "ramp" extending well below 2 kHz, which is a common cutoff point for whistlers. Time marks at the top of the spectrograms are 1 second intervals. The audible dispersion is about 2.5 seconds and the tone is pretty pure. There is some hum present at low frequencies, but this does not detract from the quality of the signal or data.



13:33:16 Two strong whistlers and several weak ones.

Team 21 Phil Hartzell Aurora, Nebraska

Phil logged and recorded several whistlers during his observations of 19-2. Conditions were generally quite noisy with lightning seen in the distance in northeast Kansas. Phil reported that the whistlers seemed to follow especially strong local sferics by a predictable time interval. This, of course, is the definition of 2-hop whistlers. Here are a couple.



02:40 UT Local sferic burst is at :02 sec.; 2-hop whistler is at 4 sec. (arrow); 4-hop echo is at :05 sec.

Team E5 Renato Romero Cumiana, Italy

Now the news:

On April 22 OPERA (Observatory PErmanent of RAdionature) was formed. It consists of the following activities:

- Two sessions of about 5 minutes every day in the morning and evening counting the number of whistlers per minute. This is using E-field and B-field receivers.
- Daily collection of solar and geophysical activity (via SEC : Space Environment Centre)
- Daily collection of weather condition data from the magnetic conjugate point (for Italy, this is South Africa). (Via Intellicast)

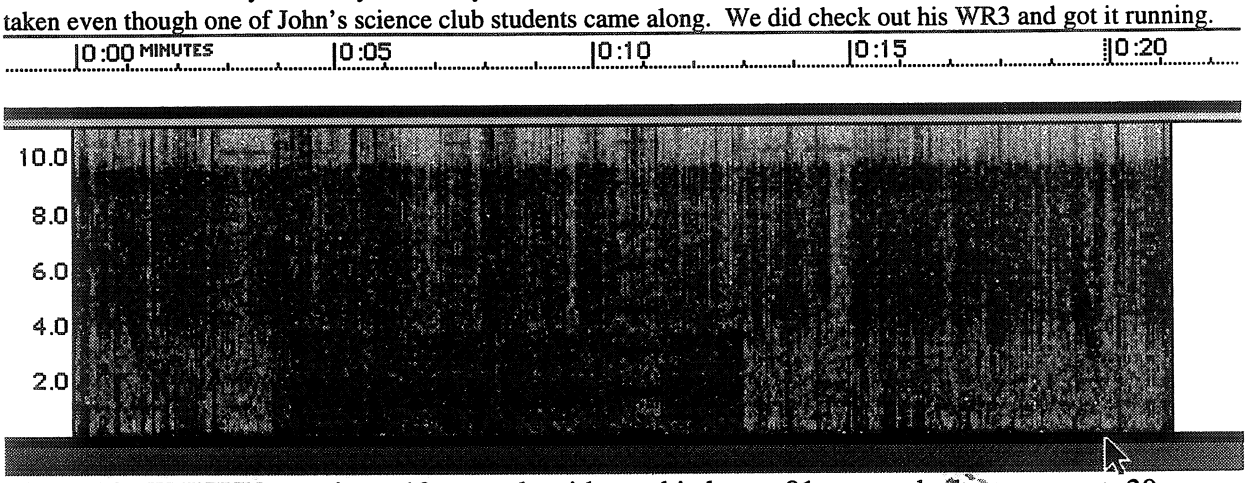
The activity will be 6 months in length and all of the data will be stored in a database, probably Excel, making it possible to show graphically the connections of whistlers with the other values. The results will be available in the fall of '97. See you at the next experience!

Team 8 Mike Dormann Seattle, Washington

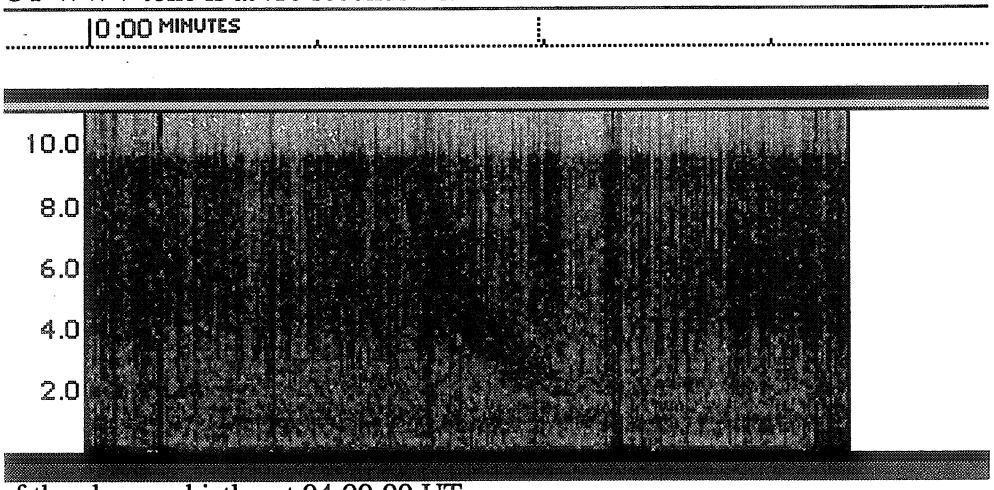
19-3 I made it to Cranberry Marsh in southwest Washington in plenty of time to set up a first class observation station. There was no wind noise or power line interference. I could hear chorus and tweeks so weak as to be whispers. Although the recording does not give justice to the signal to noise ratio of the setup, I have never had such listening conditions. If there were to be a time that I could actually hear INTMINS it would have been this time. To make a long story short, no luck.

John Currie joined me and we set up a WR3 receiving station using a 25 foot mast antenna. This was John's first shot at VLF listening and he was quite impressed. A beautiful night with not too many bugs!

The second day was rainy and windy - a real Pacific Northwest storm. Nothing worked and no data was taken even though one of John's science club students came along. We did check out his WR3 and got it running.



The 0400 UT WWV tone is at :10 seconds with a whistler at :01 sec. and a better one at :20 sec.



Close-up of the above whistler at 04:00:09 UT.

Team 24 Paul Devoe Redlands, California
Redlands High School

The newest INSPIRE team is from Redlands High School. Student members of the Redlands INSPIRE Team include:

Heather Armitage
Sonia Choi
Kim Corneille
Josh Davila
Robert Rodger
Michael Vines
Geoff Tucker

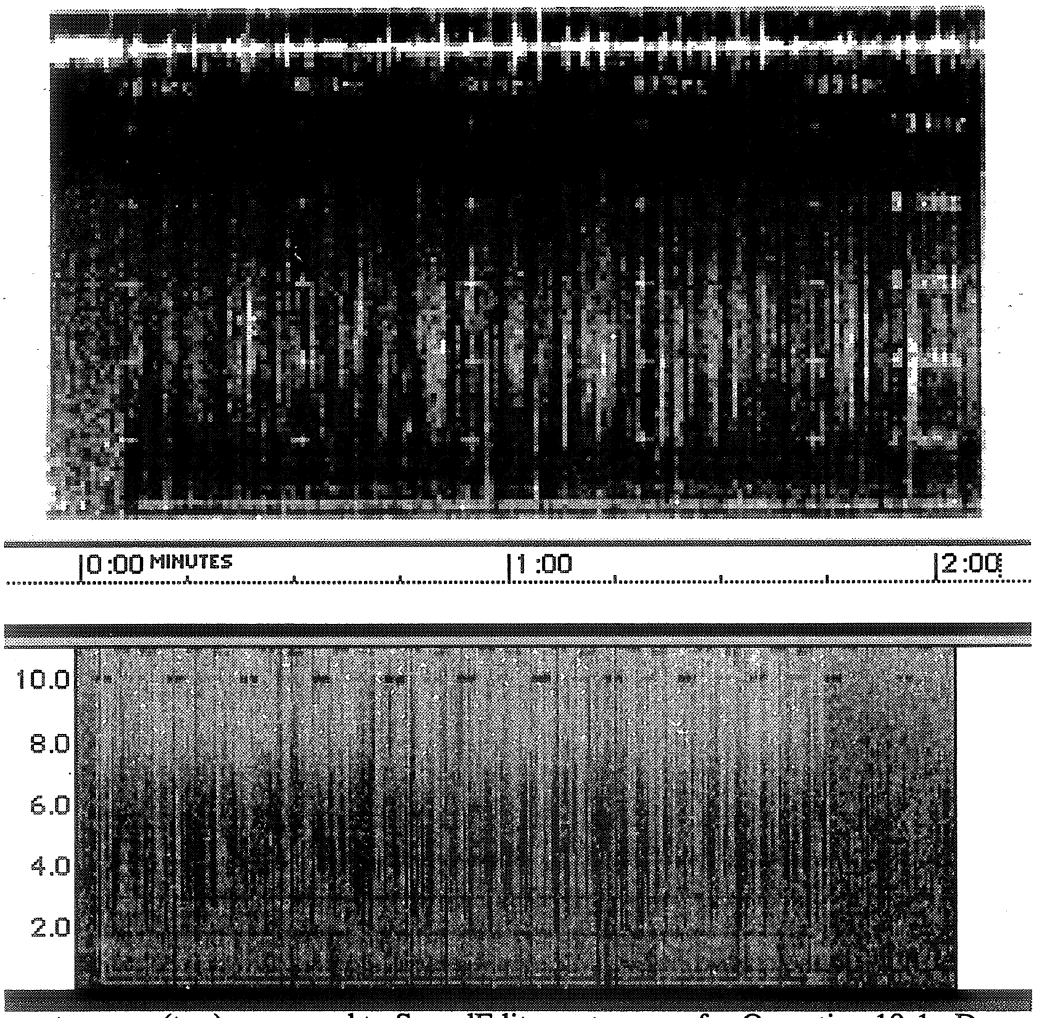
Team 15 Robert Bennett Las Cruces, New Mexico

I have enclosed a copy of my attempt at reducing and analyzing the recordings. The color printer I used to print the plots is not the best in the world and some detail has been lost. If you would, please check my work when you listen to the tapes and see if I missed anything of interest. Also, any pointers on my technique would be welcome.

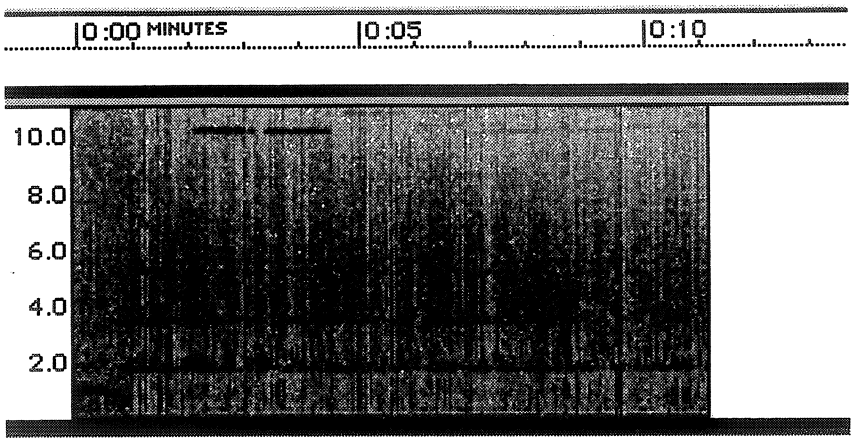
I also collected a lot of useful and interesting information on the performance of different combinations of antennas. I am still in the process of reducing the data and analyzing it. I have enough to possibly write an article for the INSPIRE Journal. Are you interested in such an article? If so, please provide details on the format you desire and suspense dates for the article.

Robert used the GRAM analysis program for the PC and produced some great results. the following is an example of his spectrograms and one done using SoundEdit Pro for comparison. The GRAM spectrograms had to be scanned into the Mac for inclusion in the *Journal*, so some loss of clarity resulted. (In other words, Robert's spectrograms are beautiful, but you can't tell from the image below!)

An article on antenna performance would be very appropriate for the Journal and much appreciated. The best format for text is Word RTF file attachments to email messages. Bitmap (.BMP) images of the spectrograms could also be sent as attachments to messages. Deadlines for articles are October 1 and March 1.



GRAM spectrogram (top) compared to SoundEdit spectrogram for Operation 19-1. Dense sferics and OMEGA present.

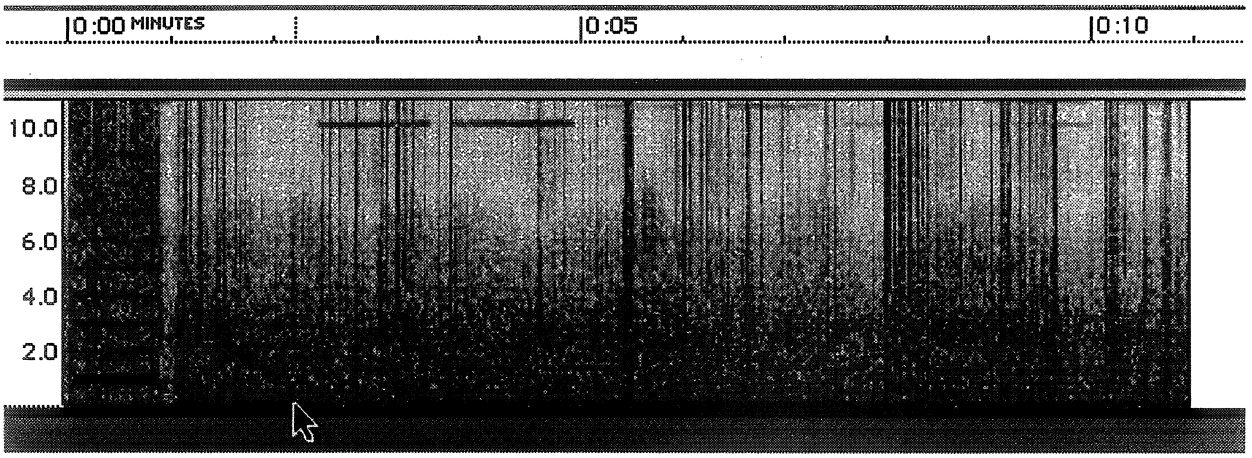


This spectrogram starts with the 0405 UT WWV tone at 1 kHz. There are four OMEGA stations present. At 10.2 kHz, the first dash (:02 - :03) is from Hawaii; the second dash (:03 - :04) is from North Dakota; the third dash (:07 - :08) is from Australia; the fourth dash (centered on :09) is from Japan.

Team 19 Larry Kramer / Clifton Lasky Fresno, California

Our E-field antenna has been improved since the last data taken in early May. With the help of Mike Staal at M2, or M-squared, Enterprises in Fresno, California, we were able to come up with a very nice vertical VLF antenna. It stands 14.6 meters (48 feet) tall. I designed a support base using an old milk crate with some slabs of aluminum bolted to it. Mike suggested using 1.5 inch aluminum tubing for the first few meters of the vertical element, getting smaller as the height is increased. A very strong fiberglass pipe insulates the antenna from ground. within a few minutes we had a superb VLF antenna at a very good price. The performance was excellent: even in the daytime we could hear a good activity level.

The weather was mostly overcast on the 20-3 data take. As the clouds began to dissipate, Comet Hale-Bopp was surprisingly visible through the haze. Just about 10 minutes before the 20-9 data take, the wind blew down my new vertical. No damage was done and it was back up in no time.



This spectrogram starts with the 0456 WWV tone (note the harmonics present up to 9 or 10 kHz); arrow points to the bottom of a nice whistler that follows the tone. Four OMEGA stations present.

Team 4 Mike Aiello Croton, New York

I have constructed my new VLF2 receiver. It went together easily and worked on the first try. This is a very nice receiver; I especially like the audio output feature. I have made two modifications to my kit to facilitate portable use for site checking:

1. I substituted a 3-conductor stereo jack for the (mono) audio output jack with the two audio channels wired in parallel to the output signal. This allows the use of readily available "Walkman" headphones for the audio output.
2. I put a 6' whip antenna in the radio enclosure behind the jacks on the left hand side, extending out the top, and a "ground plate" made from double sided pc-board affixed to the back. The whip and ground plate are connected to the + and - inputs of the board through a DPDT switch that selects either the face plate screw connections or the whip and plate. There is room for the switch on the face plate between the data output jack and the data level switch.
   This configuration allows you to use the receiver by extending the whip and holding the receiver so that your hand contacts the ground plate. Throwing the switch to the other position allows use of the face plate connections as originally intended.

I tried the receiver in the field today on a hike through a wooded area in our neighborhood. I didn't find any new recording sites (there are houses near the wood and a high level of AC hum), but the VLF2 with on-board antenna worked beautifully!

The trickiest part was figuring out the correct placement of drill holes for the antenna and switch. If you think others might be interested in these modifications, I could write them up with some diagrams and illustrations for the next Journal.

The Journal is always looking for contributions from INSPIRE participants. This would make a great article, Mike!

Team 17 Kent Gardner Fullerton, California

Because of my new work schedule, I couldn't make it to my mountain receiving location so I tried to do 23-1 here in Fullerton at a once reasonably quiet site. A new housing project ruined that so I ended up with no usable data. I will try again next time.

Is it possible to enhance any chance of receiving the INTMINS signals by redesigning the antennas? Would long wires at submultiples of any particular wavelength be more sensitive to the signals? I have thought about switching three different antennas at reasonable intervals during a pass to see if different polarizations might help. I am thinking that two long wires at right angles to each other and a vertical whip could be switched at about 6 second intervals. The exact timing would have to be thought through to account for the number of LF modulations occurring during an experimental test. Maybe a loop would be another possibility. A quiet switching circuit would have to be put together also that would not add noise in the received signal. Just a thought.

First the questions: I think that antenna design and orientation is a rich area for further investigation. Several other participants are proceeding in this area and I anticipate using the Journal as a means for sharing the results.

The basic frequency that we are looking for with INTMINS is 1 kilohertz. The wavelength of this wave is 300 kilometers! So submultiple wavelength antennas, such as half-wave and quarter-wave antennas, are sort of out of the question. The basic premise I have been using is that the longer the antenna the better since that intercepts more of the radio energy, but submultiples of the wavelength are not practical. Does anyone else have any thoughts on this?

I have tried some experiments with various orientations of whip antennas, but could find no difference in the reception. A difference might show up using long wires, though, and it would be interesting to find out.

Team E8 Zeljko Andreic Zagreb, Croatia
Rudjer Boskovic Institute

This from Goran Zgrablic:

I'm sending you this letter as one of the INSPIRE observers from Croatia. We are a group of students studying physics at Zagreb University. Our mentor, Dr. Zeljko Andreic, sent you our VLF observations from April 1996.

Unfortunately we did not have good luck with the INTMINS operations in November and December 1996. It was very cold and the roads to remote areas were completely blocked and frozen. Actually, a few passes were recorded, but in very bad conditions: it was snowing, we were close to power lines and shielded by nearby vegetation and snow. I noticed that the signal had not as much static as usual. It is probably because of the absorption of the snow.

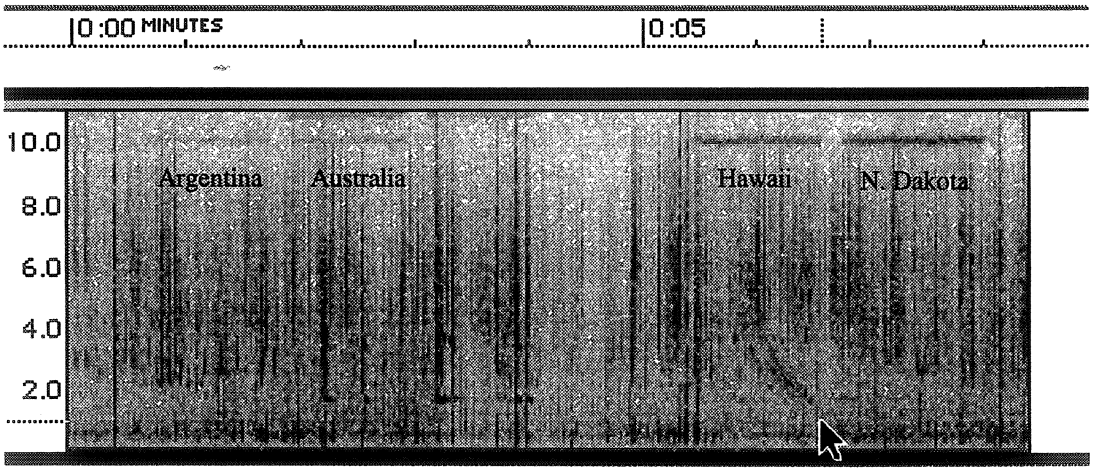
Our group has been working on VLF observations of meteors. The observation consists of parallel visual observations and VLF recording. We choose some major meteor showers, such as the Perseids, because we need very bright fireballs. If you are interested, I could write an article for the INSPIRE Journal.

I am interested! An article would be welcome.

Team 6 Bill Pine Ontario, California
Chaffey High School

Chaffey High School INSPIRE Team consisted of:

Jillian Anthony	Blake Hunter	Brad Olsan
Mike Corral	Marco Moreno	Monika Witecka
	Matt Munson	



Whistler at 0459:14 on 4/20/97. Note also the tweeks between :03 and :04 sec. Four OMEGA stations present. This was taken using the new VLF2 receiver.

Data Log Cover Sheet (copy as needed)

INSPIRE Observer Team _____ Receiver _____

Operation _____

Date _____ Tape Start Time (UT) _____

****

Operation details: Tape start time: _____ UT _____ local

Operation start time: _____ UT _____ local

Operation type: _____

Operation stop time: _____ UT _____ local

Tape stop time: _____ UT _____ local

Equipment: Receiver _____ WW V reception:

Recorder _____ _____

Antenna _____ _____

WWV radio _____ _____

Site description: _____

Longitude: _____° _____ ' W Latitude: _____° _____ ' N

Local weather: _____

Personnel: _____ _____ _____

_____ _____ _____

Team Leader address: Name _____

Street _____

_____

City, State, Zip, Country _____

INSPIRE Data (copy as needed)

INSPIRE Observer Team _____ Receiver _____

Operation _____

Date _____ Tape Start Time (UT) _____

****

Code: S - sferics 0 1 2 3 4 5 M - Mark T - tweek W - whistler O - OMEGA C - chorus
L M H

Time	Entry	Observer
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
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